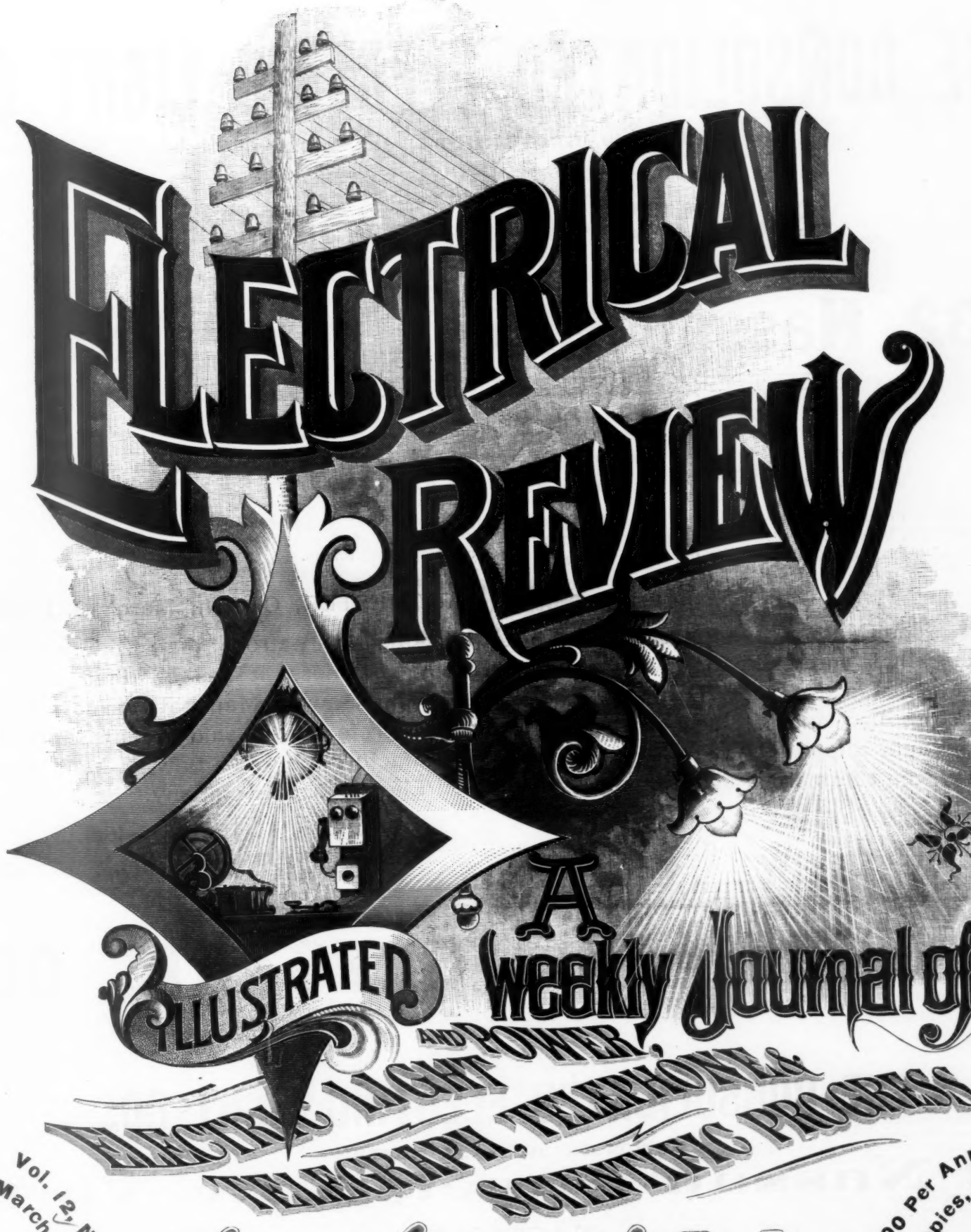

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THE CONSOLIDATED ELECTRIC LIGHT CO.

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N. T. PULSIFER, General Manager,
RICHARD H. MATHER, } Consulting Electricians.
WM. A. ANTHONY, }

MANCHESTER, CONN., March 3, 1888.

The Mather Electric Company hereby notifies its patrons that, with a view of protecting their interests and its steadily increasing business, it has obtained from the Consolidated Electric Light Company, the owner of the Sawyer-Man patents covering the manufacture, use, and sale of incandescent lamps, the protection of said patents, and will at an early date supply its patrons with lamps manufactured by the Sawyer-Man Electric Company, the commercial agent of the Consolidated Electric Light Company.

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ELECTRICAL REVIEW

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Experiments with Accumulators.

The author gives some results of a large number of experiments made with Huber's accumulators. Each cell contained eight negative plates of lead and seven positive lead plates, with four per cent. of antimony; the cells were 12 x 16 x 24 centimetres, the plates being square, and the side measuring 15 centimetres. The total weight of a cell, including acid, was 12.5 kilogrammes; the normal current was 0.635 ampere per square decimetre of plate, or 20 amperes per cell; six cells were used in series. The chief point noticed is the change of E. M. F. as the cells were alternately charged and discharged. Before charging, the E. M. F. per cell was 1.95 volts; on commencing to charge, this rose at once to 2.1 volts, and then gradually during the first 2¾ hours to 2.2 volts; in the next 1½ hours the E. M. F. increased to 2.4 volts. Gas began to be given off when the E. M F. was 2.35 volts. On disconnecting the source of electricity the E. M. F. fell to 2.1 volts. On commencing the discharge the E. M. F. was 1.95 volts, which fell to 1.85 volts after 3¼ hours' discharge, and to 1.75 volts after a further ¾ hour; on disconnecting, the E. M. F. rose to 1.9 volts. The charge comprised 89.8 ampere-hours and 196.2 watt-hours. Hence the mean E. M. F. during the charging was 2.185 volts. The discharge gave 81.4 ampere-hours or 153.7 watt-hours, or a mean E. M. F during the discharge of 1.89 volts. The efficiency in ampere-hours comes out as 90.7 per cent., or in total electrical work as 78.4 per cent. These figures agree very well with those found by von Waltenhofen with the accumulators of Farbaky and Schenek, viz., 91 per cent. and 78.5 respectively.—*Elektrotechnische Zeitschrift.*

Milling Machinery Used By Electrical Manufacturers.

The back-geared milling machine shown in Fig. 1, has been lately brought out by E. E. Garvin & Co., of this city, and is well adapted for a large class of work which does not require a very large machine, but on which heavy cuts must be taken. To this end, the aim is made very heavy, and a large cone provided to give ample belt power. The yoke is flattened off on the under side to pass close to the work, which is very convenient in many cases. The bearing of the arbor in the yoke is a straight ¾ pole, hardened and ground and split to take up wear. Provision is also made for the end thrust of the arbor. The feed of the table is by screw driven through worm and gear, both of which are hardened. The table is wide and long, and sufficiently heavy to resist springing. The knee and pan are built in proportion, and can each be adjusted to thousandths of an inch.

The spindle is large and runs in composition boxes adjustable for wear. Provision is made throughout the machine for taking up wear.

The weight of the machine complete with friction countershaft is 2,100 pounds.

The other apparatus shown are for use in keeping milling cutters sharp and in good order, and are of the fine quality that all the work bearing the stamp of E. E. Garvin & Co. has become famous for.

Technical Parlance.

Poking fun at an esteemed contemporary, the *Roller Mill* remarks:

"When we observe the ease with which our luminous Boston contemporary and exchange, *Modern Light and Heat*, handles such themes as 'Curves of Thermo-magnetic Permeability,' 'Inductoriums,' 'Normal Potential,' 'Converters,' 'Exciters,' and the like,' we are moved to admiration and envy; but when we find the same journal seriously discussing the project of getting electrical energy from the Falls of Niagara by stringing a lot of paddle-wheels on a clothes line—well, it requires several 'ohms' of 'internal resistance' to keep back a 49-candle power smile."

Application of the Deci-Ampere or Centi-Ampere Balance to the Determination of the E. M. F. of Voltaic Cells.

Kohlrausch, in his "Physical Measurements," gives a description of Poggendorff's method of two opposed circuits, one containing a galvanoscope and the other a tangent galvanometer. The present method is the same, the tangent galvanometer being replaced by a standard ampere balance.

A battery of a sufficient number of cells is joined in circuit through a reversing key with a rheostat, a deci-ampere balance, and a standard resistance. The poles of the cell to be tested are connected in circuit with a key and a sensitive mirror-galvanometer to the two ends of the standard resistance in such a way that both the battery and the cell to be tested tend to send a current in the same direction through that resistance. Care should be taken that the circuit of the cell to be tested is well insulated, and that both it and the standard resistance are free from other E. M. F. The standard resistance must be of such a form that no sensible error is introduced through heating. For use with the deci-ampere balance a resistance of two ohms is suitable, and this may best be constructed by winding an insulated platinoid wire one millimetre in diameter on a brass tube capable of holding half a litre of water, the temperature of which, when it does not differ much from that of the air, will be the temperature of the coil. Such a resistance coil will carry a current of one ampere for an hour without changing its resistance more than one-tenth per cent.

The results of tests on four Clark standard cells were almost identical with one another, and gave 1.439 Rayleigh, or 1.442 legal volts at 11° C.; allowing the temperature correction of—0.077 per cent. per degree rise of temperature, this reduces to 1.4346 Rayleigh volts at 15° C, which differs by less than one-thirtieth per cent. from Rayleigh's value of 1.435 at 15° C.

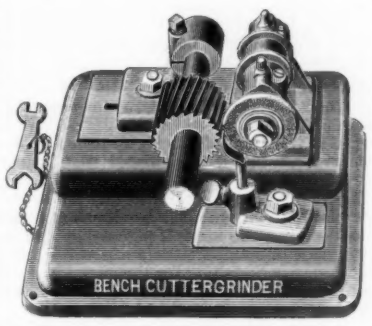

FIG. 2.—BENCH CUTTER GRINDER.

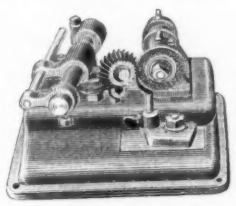

FIG. 3.—GRINDING BEVEL CUTTERS.

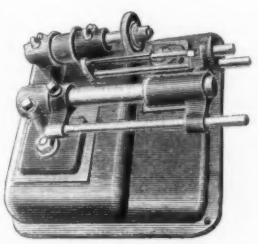

FIG. 4.—GRINDING TAPER REAMERS.

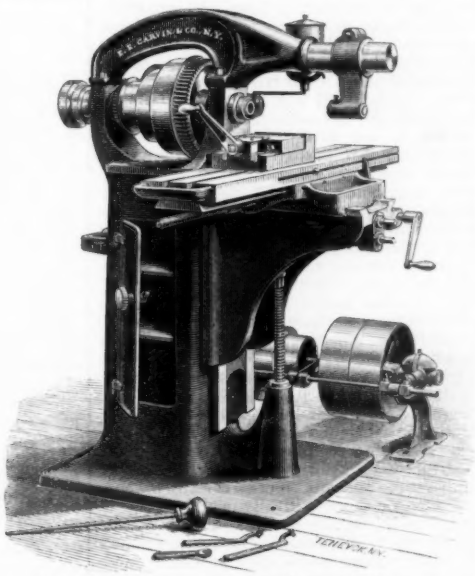

FIG. 1.—GARVIN & CO.'S MILLING MACHINE.

Electrical Religion.

They are making church organs now so that they can be played by electricity. Electricity can do a great deal for religion, and doubtless will as soon as some high-minded inventor finds time to give it a chance. The time will come when graduates of theological seminaries will be required to be expert electricians, and when pastors of churches, instead of saying "Let us pray," will simply press a little button and send a little electricity into the system of each member of the congregation. The time for putting a quarter into the contribution box will be communicated in the same way, and if any stiff-necked, hardened sinner fails to bow his head reverently or fish out a quarter at the proper time, the current can be turned on stronger and kept on until he is brought to time.—*Eugene Field in Chicago News.*

The Telephone Decision.

THE OPINION OF THE U. S. SUPREME COURT UPHOLDING THE BELL PATENT—WHAT THE DISSENTING JUDGES SAY.

At Washington, in the Supreme Court of the United States, in the matter of the telephone appeals, the following judgment was announced on Monday, March 19:

The CHIEF JUSTICE—I have been instructed by the court to announce its judgment this morning in the six cases known as the telephone cases, and as the opinion is rather long, and my voice is weak and not under control, I have asked Judge Blatchford to read it.

THE CASES.

Mr. Justice BLATCHFORD—This opinion is in case No. 113, *Amos E. Dolbear* and other appellants, versus *The American Bell Telephone Co.*, an appeal from the Circuit Court of the United States for the District of Massachusetts.

In cases No. 361 and 362, which are cross-appeals from the Circuit Court of the United States for the Southern District of New York, one by the *Molecular Telephone Co.* and others, appellants, against *The American Bell Telephone Co.* and another, and a cross-appeal by *The American Bell Telephone Co.* and another, versus *The Molecular Telephone Co* and others.

Another case is No. 709, *The Clay Commercial Telephone Co.* and others, appellants, versus *The American Bell Telephone Co.* and others; an appeal from the Circuit Court of the United States for the Eastern District of Pennsylvania.

Another is case 770. *The People's Telephone Co.* and others, appellants, against the *The American Bell Telephone Co.* and others, an appeal from the Circuit Court of the United States for the Southern District of New York.

Another is case No. 771, *The Overland Telephone Co.* and others, appellants, against *The American Bell Telephone Co.* and others, an appeal from the Circuit Court of the United States for the Southern District of New York.

The opinion is written by the Chief Justice.

WHAT PROF. BELL CLAIMS.

The important question which meets us at the outset in each of these cases, is as to the scope of the fifth claim of Bell's patent of March 7, 1876, which is as follows:

The method of and apparatus for transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations similar in form to the vibrations of the air accompanying the said vocal or other sounds, substantially as set forth.

It is contended that this embraces the art of transferring to or impressing upon a current of electricity, the vibrations of air produced by the human voice in articulate speech, in such a way that the speech will be carried to and received by a listener at a distance on the line of the current. Articulate speech is not mentioned by name in the patent. The invention, as described, consists in the employment of a vibratory or undulatory current of electricity, in contradistinction to a merely intermittent or pulsatory current, and of a method of, and apparatus for producing electrical undulations upon the line wire.

A pulsatory current is described as one caused by sudden or instantaneous changes of intensity, and an electrical undulation as the result of gradual changes of intensity, exactly analogous to the changes in the density of air occasioned by simple pendulous vibrations.

Among the uses to which this art may be put, is said to be the telegraphic transmission of noises or sounds of any kind; and it is also said that the undulatory current, when created in the way pointed out, will produce through the receiver at the receiving end of the line, a similar sound to that uttered into the transmitter at the transmitting end. One of the means of imparting the necessary vibrations to the transmitter to

produce the undulations may be the human voice. Articulate speech is certainly included in this description for it is an uttered sound produced by the human voice.

It is contended, however, that "vocal sounds" and "articulate speech" are not convertible terms, either in acoustics or in telegraphy. It is unnecessary to determine whether this is so or not. Articulate speech necessarily implies a sound produced by the human voice. As the patent, on its face, is for the art of changing the intensity of a continuous current of electricity by the undulations of the air caused by the sonorous vibrations, and speech can only be communicated by such vibrations, the transmission of speech in this way must be included in the art. The question is not whether vocal sounds and articulate speech are used synonomously as scientific terms, but whether articulate speech is one of the vocal or other sounds referred to in this claim of the patent. We have no hesitation in saying that it is, and that if the patent can be sustained to the full extent of what is now contended for, it gives to Bell, and those who claim under him, the exclusive use of this art for that purpose until the expiration of the statutory term of his patented rights.

In this art, or what is the same thing under the patent law, this *process*, this *way* of transmitting speech, electricity, one of the forces of nature, is employed; but electricity left to itself will not do what is wanted. The art consists in so controlling the force as to make it accomplish the purpose.

It had long been believed that if the vibrations of air caused by the voice in speaking could be reproduced at a distance by means of electricity, the speech itself would be reproduced and understood. How to do it was the question, Bell discovered that it could be done by gradually changing the intensity of a continuous electrical current, so as to make it correspond exactly to the changes in the density of the air caused by the voice. This was his art. He then devised a way in which these changes of intensity could be made and speech actually transmitted. Thus his art was put in a condition for practical use. In doing this, both discovery and invention, in the popular sense of those terms, was involved; discovery in finding the art, and invention in devising means of making it useful; and for such discovery and such invention, the law has given the discoverer and inventor the right to a patent; as discoverer, for the useful art, process and method of doing the thing he has found, and as inventor, for the means he has devised to make the discovery one of actual value. Other inventors may compete with him for the ways of giving effect to the discovery, but the new art he has found will belong to him and those claiming under him, during the life of his patent. If another discovers a different art or method of doing the same thing, reduces it to practical use, and gets a patent for his discovery, the new discovery will be the property of the new discoverer, and thereafter the two will be permitted to operate, each in his own way, without interference by the other. The only question between them will be whether the second discovery is in fact different from the first.

A patent for the art does not necessarily involve a patent for the particular means employed for using it. Indeed, the mention of any means in the specifications or descriptive portion of the patent is only necessary to show that the art can be used; for it is only useful arts, arts which may be used to advantage, that can be made the subject of a patent. The language of the statute is:

> Any person who has invented or discovered any new or useful art, machine, manufacture or composition of matter may obtain a patent.

That is section 4886 of the Revised Statutes. It is an art, a process which is useful, and is as much the subject of a patent as a machine, manufacture or composition of matter. Of this there can be no doubt. It is abundantly supported by the authorities. *Corning* v. *Burden*, 15 How., 252–271. *Tilghman* v. *Proctor*, 12 How., 707–735. *Fermentation Company* v. *Maus*, 20 Fed. Rep., 725.

What Bell claims, is the art of creating changes of intensity in a continuous current of electricity exactly corresponding to the changes of density in the air caused by the vibrations which accompany vocal or other sounds, and of the use of the electric condition that is thus created for sending and receiving articulate speech telegraphically. For that, among other things, the patent of 1876 was, in our opinion, issued, and the point to be decided is, whether as such a patent it can be sustained.

In *O'Reilly* v. *Morse*, (15 How.) it was decided that a claim in broad terms for the use of the motive power of the electric or galvanic current for making intelligible characters, letters or sounds at any distance, although a new application of the power was made by Morse, was void, because it was a claim for a patent for an effect produced by the use of electro-magnetism, distinguished from the process or machinery necessary to produce it.

But a claim for making use of the motive power of magnetism when developed by the action of said current, substantially as set forth in the foregoing description, as a means of operating or governing the motion or machinery that is to impart signals in any desired manner for the purpose of producing telegraphic communication at any distance, was sustained. The effect of the decision was, therefore, that the use of magnetism as a motive power, without regard to the particular process with which it was connected in the patent, could not be claimed; but that its use in such a connection could.

In the present case the claim is not for the use of a current of electricity in its natural state, as it comes from the battery; but for putting a continuous current in a closed circuit into a certain specific condition suited to the transmission of vocal and other sounds, and using it in that condition for that purpose. So far as at present known, without this peculiar change in its condition, it will not serve as a medium for the transmission of speech, but with the change it will. Bell was the first to discover this fact, and how to put such a current into such a condition. What he claims is its use in that condition for that purpose, just as Morse claimed his current in his condition for his purpose. But we see nothing in the Morse case to defeat Bell's claim. On the contrary, it is in all respects sustained by that authority. It may be that electricity cannot be used at all for the transmission of speech except in the way Bell has discovered it, and that, therefore, practically his patent gives him its exclusive use for this purpose. But that does not make his claim one for the use of electricity as distinguished from the particular process with which it is connected in his patent. It will, if it is true, show more clearly the great importance of his discovery, but it will not invalidate his patent.

THE SPECIFICATION.

But it is insisted that his claim cannot be sustained, because when the patent was issued Bell had not, in fact, completed his discovery. While it is conceded that he was acting on the right principle and had adopted the true theory, it is claimed that his discovery lacked that practical development which was necessary to make it patentable. In the language of counsel "there was still work to be done, work calling for the exercise of the utmost ingenuity and calling for the very highest degree of practical invention"

It is quite true that when Bell applied for his patent he had never actually transmitted telegraphically spoken words so that they could be distinctly heard and understood by the listener at the receiving end of his line, but in his specifications he did describe accurately and with admirable clearness, his process, that is to say, the exact electrical condition that must be created to accomplish the purpose. He also described with sufficient precision to enable one skilled in such matters to make it, a form of apparatus, which if used in the way pointed out, would produce the required effect, receive the words and carry them to and deliver them at the appointed place. The particular instrument which he had, and which he used in his experiments did not under the circumstances in which it was tried, reproduce the words spoken so that they could be clearly understood; but the proof is abundant, and of the most convincing character that other instruments carefully constructed and made in exact accordance with the specifications without any additions whatever, have operated, and will operate successfully. A good mechanic of proper skill in matters of the kind can take the patent and by following the specifications strictly, can, without more, construct an apparatus which, when used in the way pointed out, will do all that it is claimed the method or process will do.

Some witnesses have testified that they were unable to do it, but this shows that they, with the particular apparatus they had and the skill they employed in its use, were not successful; not that others with another apparatus perhaps more carefully constructed or more skillfully contrived would necessarily fail. As was said in *Loom Company* v. *Higgins*, when the question is whether a thing can be done or not, it is always easy to find persons to show how not to do it. If one succeeds, that is enough; no matter how many others fail. Opposite results will show that in the one case the apparatus used was properly made, and carefully adjusted with a knowledge of what was required, and skillfully used; and that in the other it was not. The law does not require that a discoverer or inventor, in order to get a patent for a process, must have succeeded in bringing the art to the highest degree of perfection. It is enough if he describes the method with sufficient clearness and precision to enable those skilled in the matter to understand exactly what the process is, and if he points out some practicable way of putting it in operation. This Bell did.

He described clearly and distinctly his process of transmitting speech telegraphically by creating changes in the intensity of a continuous current or flow of electricity in a closed circuit, exactly analagous to changes of density in the air occasioned by the undulatory motion given to it by the human voice in speaking. He then pointed out two ways in which this might by done, one, by the vibration or motion of bodies capable of inductive action or by the vibration of the conducting wire itself in the neighborhood of such bodies; and the other by alternately increasing and diminishing the resistance of the circuit, or by alternately increasing and diminishing the power of the battery. He then states that he prefers to employ for his purpose an electro-magnet having a coil on one of its legs, and he describes the construction of the particular apparatus, shown in the patent as figure 7, in which the electro-magnet or magneto method was employed. This was the apparatus which he himself used without entirely satisfactory results, but which Professor Cross, Mr. Watson and Dr. Blake, testify has done and will do what was claimed for it, transmit speech successfully, but not as well indeed as another constructed upon the principle of the microphone or variable resistance method.

An effort was made in the argument to confine the patent to the magneto instrument, and such modes of creating electrical undulations as could be produced by this form of apparatus, the position being that such an apparatus necessarily employed a closed circuit incapable of being opened, and a continuous current incapable of being intermittent. But this argument ignores the fact that the claim is, first, for the process, and second, for the apparatus. It is to be read as, *first*, a claim for the method of transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations similar in form to the vibrations of air accompanying the vocal or other sounds substantially as set forth, and, *second*, for an apparatus for transmitting vocal or other sounds telegraphically as herein described, by causing electrical undulations, substantially as set forth.

The *method* "as herein described" is to cause gradual changes in the intensity of the electrical current used as the medium of transmission, which shall be exactly analogous to the changes in the density of the air occasioned by the peculiarities in the shapes of the undulations produced in speech, in the manner substantially as set forth: that is to say, by the vibration or motion of bodies capable of inductive action, or by the vibration of the conducting wire itself in the neighborhood of such bodies, which is the magneto method; or by alternately increasing or diminishing the resistance of the circuit, or by alternately increasing and diminishing the power of the battery, which is the variable resistance method. This is the process which has been patented, and it may be operated in either of the ways specified. The circuit must be kept closed to be used successfully; but this does not necessarily imply that it must be so constructed or so operated upon as to be incapable of being opened. If opened, it will fail to act for the time being, and the process will be interrupted; but there is nothing in the patent which requires it to be operated by instruments which are incapable of make and break. The *apparatus*, "as herein described," which is included in the claim, is undoubtedly one in which the electro-magnet is employed, constructed substantially as set forth in the specification. The one acting on the variable resistance mode is not described, further than to say that the vibration of the conducting wire in mercury or other liquid included in the circuit occasions undulations in the current; and no very specific directions are given as to the manner in which it must be constructed. The patent is both for the magneto and variable resistance *methods* and particularly for the magneto *apparatus* which is described or its equivalent. There is no patent for any variable resistance *apparatus*.

It is undoubtedly true that when Bell got his patent he thought the magneto method was the best. Indeed, he said in express terms he preferred it. But that does not exclude the use of the other, if it turns out to be the most desirable way of using the process under any circumstances. Both forms of apparatus operate on a closed circuit by a gradual change of intensity, and not by alternately making and breaking the circuit or by sudden and instantaneous changes, and they each require to be so adjusted as to prevent interruptions. If they break, it is a fault, and the process stops until the connection is restored.

"BELL DISCOVERED THE WAY OF DOING IT."

It is again said that the claim, if given its broad construction, is virtually a claim for speech transmission by transmitting it, or in other words, for such doing of the thing as is probable by doing it. It is true Bell transmits speech by transmitting it; and that long before he did so it was conceived by scientists that it could be done by means of electricity, if the requisite electrical effect could be produced. Precisely how that subtle force operates under Bell's treatment, or what form it takes no one can tell. All we know is, that he found that by changing the intensity of a continuous current so as to make it correspond exactly to the changes in density of the air caused by sonorous vibrations, vocal and other sounds could be transmitted and heard at a distance. This is the thing to be done. Bell discovered the way of doing it. He uses electricity as the medium for that purpose just as air is used within speaking distance. In effect, he prolongs the air vibrations by the use of electricity. No one before him had found out how to use electricity with the same effect. To use it with success it must be put in a certain condition. What that condition was he was the first to discover, and with his discovery he astonished the scientific world. Professor Henry, one of the most eminent scientists of the present century, spoke of it as the greatest marvel hitherto achieved by the telegraph. The thing done by Bell was the transmitting of audible speech through long telegraph lines. Sir William Thomson, on returning to his home in England in August or September, 1876, after seeing at the Centennial Exhibition in Philadelphia what Bell had done and could do by his process, spoke in this way of it to his countrymen:

> Who can but admire the hardihood of invention, which devised such a slight means to realize the mathematical conception, that if electricity is to convey all the delicacies of quality which distinguish articulate speech, the strength of the current must vary continuously as nearly as may be in simple proportion to the velocity of the particle of air engaged in constituting the sound.

Surely a patent for such a discovery is not to be confined to the mere means he improvised to prove the reality of his conception.

CONCERNING THE REIS APPARATUS.

We come now to consider the alleged anticipation of Philipp Reis; and here it is to be always kept in mind that the question is not whether the *apparatus*, devised by Reis to give effect to his theory, can be made with our present knowledge, to transmit speech; but whether Reis had in his time found out a way of using it successfully for that purpose, not as to the character of the apparatus, but as to the mode of treating the current of electricity on which the apparatus is to act, so as to make that current a medium for receiving vibrations of air created by the human voice in articulate speech at one place, and in effect delivering them at the ear of the listener in another place. Bell's patent is not alone for the particular apparatus that he describes, but for the process that apparatus was designed to put into use. His patent would be just as good if he had actually used the Reis apparatus in developing the process for which it was granted. That Reis knew what had to be accomplished in order to transmit speech by electricity is very apparent, for in his first paper he said:

> Since it is possible to produce anywhere or in any manner vibrations whose curves shall be the same as those of any given tone or combination of tones, we shall receive the same impression as that tone or combination of tones would have produced on us.

Bourseul also knew before Reis that this was the case, for in a communication published in the Paris journals in 1854 he said:

> When you reproduce precisely these vibrations, to wit, the vibrations made by the human voice in uttering syllables, you will reproduce precisely those syllables.

Reis discovered how to reproduce musical tones, but he did no more. He could sing through his telephone, but he could not talk. From the beginning to the end he has conceded this. In his first paper he said:

> Hitherto it has not been possible to produce the tones of human speech with a distinctness sufficient for every one. The consonants are for the most part reproduced pretty distinctly, but the vowels as yet not in an equal degree. The cause of this I will attempt to explain.

And again:

> I have succeeded in constructing an apparatus with which I am enabled to reproduce the tones of various instruments, and even to a certain extent the human voice.

None of the many writers whose papers are found in the records, claim more than this for Reis or his discovery. Although his first paper was published in 1861, Bell did not appear as a worker in the same field of scientific research until nearly 15 years afterwards. No advance had been made by the use of what Reis had contrived, nor by the use of his method, towards the great end to be accomplished. He caused his instrument to be put in the market for sale, and both he and those he employed for that purpose, took occasion to call attention to the instruments by their prospectus, catalogues and otherwise, describing what they were and what they would do. In his own prospectus, which was published in 1863 and attached to the apparatus, he said:

> Every apparatus consists of two parts, the telephone proper and the receiver. These two parts are placed at such distance from each other that the singing or toning of a musical instrument can be heard in no other way from one station to the other except through the apparatus.
>
> Both parts are connected with each other and with the battery B, like common telegraphs * * * The galvanic current goes * * * through the copper strip to the platinum leaf on the middle of the membrane, then through the foot of the angle to the screw *b*, in whose hollow a small drop of mercury is placed * * *
>
> If now sufficiently strong tones are produced in front of the sound-opening S, through the vibrations of the same, the membrane and the angular-shaped little hammer lying upon it are set in vibration; *the circuit is alternately opened and closed at every full vibration* and hereby are produced in the iron rod of the spiral at station C the same number of vibrations, and those are perceived there as tone or tone combinations.
>
> Besides the human voice there can be produced (according to my experience) just as well the tone of good organ pipes from F—*c* and those of the piano.

Albert, the mechanician employed to make the instruments, in his catalogue, published in 1866, enumerates among the things he has for sale "the telephone of Reis for reproducing tones by electricity;" and in a work

on electricity by Ferguson, published in London and Edinburgh, in 1867, it is said in speaking of the telephone:

This is an instrument for telegraphing notes of the same pitch. Any noise producing a single vibration of the air, when repeated regularly a certain number of times a second, not less than 32, produces, as is well known, a musical sound. A person when singing any note causes the air to vibrate so many times per second, the number varying with the pitch of the note he sings. The higher the note the greater the number of vibrations. If we then by any means can get these notes to break a closed circuit, a note sung at one station can be reproduced, at least as far as pitch is concerned, at another. The Reis telephone, invented in 1861, accomplishes this in the following way.

It is needless to quote further from the evidence on this branch of the case. It is not contended that Reis ever succeeded in practically transmitting speech, but only that his instrument was capable of it if he had known how. He did not know how. All his experiments in that direction were failures. With the help of Bell's later discoveries in 1875, we now know why he failed.

As early as 1854 Bourseul, in his communication which has already been referred to, had said substantially that if the vibrations of air produced by the human voice in articulate speech could be reproduced by means of electricity at a distance, the speech itself would be reproduced and heard there. As a means of stimulating inquiry to that end, he called attention to the principle on which the electric telegraph was based, and suggested the application of that principle for such a purpose. He said:

The electric telegraph is based on the following principle: An electric current passing through a metallic wire circulates through a coil around a piece of soft iron, which it converts into a magnet. The moment the current stops, this piece of iron ceases to be a magnet. This magnet takes the name of electro-magnet.

This magnet, the electro-magnet, can thus alternately attract or let go a movable plate, which by its movements back and forth, produces the conventional signals used in telegraphy.

Then, after referring to the mode in which speech is transmitted by the vibrations of the air, he said;

Suppose a man speaks near a movable disc sufficiently flexible to lose none of the vibrations of the voice, and that this disc alternately makes and breaks the connection with the battery; and you may have at a distance another disc which may simultaneously execute the same vibrations.

That Reis was working all this time, from the beginning to the end of his experiments, upon the principle of the telegraph as thus suggested by Bourseul, is abundantly proved. In his first paper, after describing his cubical block apparatus, he said:

If now tones or a combination of tones are produced in the neighborhood of the blocks, so that sufficiently powerful waves enter the opening *a*, then these sounds cause the membrane *b* to vibrate. At the first condensation the hammer-like wire *d* is pushed back; at the rarefaction it cannot follow the retreating membrane, *and the current traversing the strip remains broken*, until the membrane, forced by a new condensation, presses the strip (proceeding from *p*) against *d*. In this way *each sound causes a breaking and closing of the current*.

Such was the beginning and it was maintained persistently to the end, as well by Reis as by those who availed themselves of what he was doing. To this the Reis-Legat apparatus forms no exception, for in the paper describing it, Legat says:

The operation of the apparatus described is as follows:

When at rest the galvanic circuit is closed, when the air, which is in the tube *a b* of the apparatus, Fig. 4 A, is alternately condensed and rarefied by speaking into it (or by singing or introducing the tones of an instrument), a movement of a membrane closing the smaller opening of the tube is produced, corresponding to such condensation or rarefaction. The lever *c d* follows the movements of the membrane and opens and closes the galvanic circuit at *d q*, so that at each condensation of the air in the tube the circuit is opened, and at each rarefaction the circuit is closed.

In consequence of this operation, the electromagnet of the apparatus, Fig. 4 B, in accordance with the condensations and rarefactions of the column of air in the tube *a b*, Fig. 4 B, is correspondingly demagnetized and magnetized, and the armature of the magnet is set into vibrations like those of the membrane in the transmitting apparatus.

"REIS STOPPED AND FAILED."

We have not had our attention called to a single item of evidence which tends in any way to show that Reis, or any one who wrote about him, had in his mind anything else than that the intermittent current caused by the opening and closing of the circuit could be used to do what was wanted. No one seems to have thought that there could be any other way. All recognized the fact that the minor differences in the original vibrations had not been satisfactorily reproduced, but they attributed it to the imperfect mechanism of the apparatus used, rather than to any fault in the principle on which the operation was made to depend.

It was left to Bell to discover that the failure was due not to workmanship, but to the principle which was adopted as the basis of what was to be done. He found that what he called the intermittent current, one caused by alternately opening and closing the circuit, could not be made, under any circumstances, to reproduce the delicate forms of the air vibrations caused by the human voice in articulate speech; but that the true way was to operate on an unbroken current, by increasing and diminishing its intensity. This he called a vibratory or undulatory current, not because the current was supposed to actually take that form, but because that language expressed with sufficient accuracy his idea of a current which was subjected to gradual changes of intensity, exactly analogous to the changes of density in the air occasioned by its vibrations. Such was his discovery, and it was new. Reis never thought of it and he failed to transmit speech telegraphically. Bell did, and he succeeded. Under such circumstances it is impossible to hold that what Reis did was an anticipation of the discoveries of Bell. To follow Reis is to fail, but to follow Bell is to succeed. The difference between the two is just the difference betwen failure and success. If Reis had kept on he might have found out the way to succeed; but he stopped and failed. Bell took up the work and carried it on to a successful issue.

THE OTHER ALLEGED ANTICIPATIONS OF BELL'S INVENTION.

As to what is shown to have been written and done by Dr. Van der Weyde, it is only necessary to say that he copied Reis, and it was not until after Bell's success that he found out how to use a Reis instrument so as to make it transmit speech. Bell taught him what to do to accomplish that purpose.

As to James W. McDonough, we presume it will not be claimed that he is entitled to more than he asked for in his application for a patent, filed in the Patent Office, April 10th, 1876. There a circuit breaker, so adjusted as to break the connection by the vibration of the membrane is made one of the elements of his invention. The Patent Office was clearly right in holding him to have been anticipated by Reis.

The patents of Cromwell Fleetwood Varley, of London, England, one dated June 2d, 1868, and the other October 8th, 1870, were for improvements in the electric telegraph. The objects of the invention covered by the first are to cut off the disturbance arising from earth currents, and to obtain a high speed of signaling in long circuits; and the object of the second was the increase of the transmitting power by enabling more than one operator on a single wire to send more than one message to independent stations. In the specification it is said:

By my invention I superpose upon the currents used for working the ordinary telegraphs rapid undulations or waves which do not practically alter the mechanical or chemical power of the ordinary signal currents, and by new apparatus, hereinafter described, these undulations are made to produce distinct and independent audible or other signals so long as these undulations are produced, whether ordinary signal currents be flowing or not.

In short, there is nothing in any part of the specifications to indicate that the patentee had in his mind undulations resulting from gradual changes of intensity exactly analogous to the changes in the density of air occasioned by simple pendulous vibrations, which was Bell's discovery, and on which his art rests. His purpose was to superpose, that is to say, to place upon the ordinary current, another, which by the action of the make and break principle of the telegraph, would do the work he wanted.

THE WORK OF DANIEL DRAWBAUGH.

Another alleged anticipation is that of Daniel Drawbaugh. Bell got his patent March 7th, 1876, and the fortunate accident which led to his discovery occurred June 2d, 1875. Active litigation to enforce the patent rights was begun by his company on the 12th of September, 1878, with a suit in the Circuit Court of the United States for the District of Massachusetts, against Peter A. Dowd. This suit was defended by the *Western Union Telegraph Co.*, and vigorously contested. The answer was filed November 4, 1878, setting up alleged anticipation by Gray, Edison, Dolbear and others. The record fills 1,200 printed pages; but before a decision was reached the case was compromised, and a decree entered by consent. The litigation ended some time in the latter part of the year 1879. The last deposition was taken on the 19th of September in that year.

The next contested suit was brought in the same court on the 28th of July, 1880, against *Albert Spencer* and others. An answer was filed in this case September 6, 1880, and depositions afterwards taken, some of those in the Dowd suit being used in this by stipulation. On the 27th of June, 1881, a decision was announced by Judge LOWELL, sustaining the patent, upon which a decree was entered.

On the 14th of November, 1879, Mr. A. G. Tisdel filed in the Patent Office an application for a patent for a new and useful improvement in speaking telephones. On the 18th of November, 1879, Frank A. Klemm also filed an application for a patent for a new and useful improvement in telephone transmitters. These inventions were transferred by assignment to Ernest Marks and Frank A. Klemm, of New York city, —— Levy, of Cincinnati, and Simon Wolf, of Washington. On the 6th of March, 1880, these parties entered into a mutual agreement, to the effect that each and all their interests in said improvements and inventions, and the letters patent to be issued therefor, should be merged and consolidated as the common stock in a corporate body under the laws either of the State of Ohio or New York, or the general laws of the United States, relating to the formation of corporations in the District of Columbia, or in such other States and Territories as might be found necessary hereafter.] [This agreement was recorded in the Patent Office March 10th, 1880.

On the 6th of May, 1880, Edgar W. Chellis, a merchant of Harrisburg, Pennsylvania, H. W. Jacobs, a lawyer of the same place, and Lysander Hill, a lawyer then residing in Washington, in the District of Columbia, made an arrangement with Daniel Drawbaugh, by which they were to become jointly interested with him in his alleged telephone inventions, each to have a quarter interest. Nothing was paid for this, but each of the parties was to have one-quarter of anything that should be realized from the enterprise. On the 24th of May, 1880, Simon Wolf, one of the parties interested in the Klemm and Tisdel inventions, visited Harrisburg, on business with Chellis in reference to telephone matters. On the 18th of May, six days before this visit, a patent was issued to Wolf and his associates upon the invention of Tisdel. While Wolf was in Harrisburg, negotiations were begun by Chellis for the transfer of the Drawbaugh inventions, and these negotiations resulted in a conditional contract on the 22d of June, by reason of which Chellis, Jacobs, Hill and Drawbaugh went to Washington. There on the 21st of July, 1880, Drawbaugh claiming to have invented "new and useful improvements in the transmission of vocal speech, and the apparatus to be used for those purposes, for which I am about to make application for letters patent of the United States," assigned to Klemm, Marx, Wolf and Levy, the full and exclusive right to the said inventions as fully set forth and described "in the specifications prepared and executed by me, dated 21st July, 1880, preparatory to obtaining Letters Patent of the United States therefor." He at the same time, and by the same instrument, authorized and requested the Commissioner of Patents to issue the patents to his assignees, each as assignee of one-quarter part. The specification referred to in the assignment has not been put in evidence in any of the cases. In the course of taking the testimony it was called for by the Bell company, but the counsel for the opposite party declined to produce either the original or a copy from the Patent Office. The assignment was recorded in the Patent Office July 22d, 1880, and in the official Digest of Assignments, the following notice appears:

About to make application. Specification dated July 21st, 1880.

INCORPORATION OF THE PEOPLE'S TELEPHONE COMPANY.

On the 30th of August, 1880, the People's Telephone Co. was incorporated under the general laws of New York, with an authorized capital stock of $5,000,000, for manufacturing, constructing, owning, furnishing, letting and selling telephones and the apparatus used therewith under the inventions and patents of Abner G. Tisdel, Frank A. Klemm, Daniel Drawbaugh, and other inventions and patents which may hereafter be assigned to that company. On the 4th of September, 1880, Klemm, Loth, Marx and Wolff, in consideration of $4,999,550 as represented by 99,991 shares of stock, assigned and transferred to that company all their interests in the Klemm, Tisdel and Drawbaugh inventions, those of Drawbaugh being described as "inventions in telephones made by Daniel Drawbaugh, of Eberly's Mills, Cumberland county, Pennsylvania, for which applications for patents were made on or about the 21st of July, 1880, and which were assigned to us on the 31st of July, 1880, as more particularly appears in the deed of assignment, recorded in the United States Patent Office." For the asssignment from Drawbaugh to Klemm, Marx, Loth and Wolff, $20,000 was paid in money to Chellis, Jacobs and Hill, and they were allowed to have a certain amount of the stock of the proposed corporation then formed. What amount they actually got, Chellis, who was sworn as a witness in the case, declined to state, but he admitted it was large.

At this time and in this way, the attention of the general public was called, for the first time, to the fact that Drawbaugh claimed to have anticipated Bell in the discovery of the telephone. Bell's success had been proclaimed more than four years before, at the Centennial Exhibition in Philadelphia. In the meantime inventions in aid of his discovery had been multiplied. According to the testimony of Park Benjamin, more than 100 patents had then been issued and indexed under the word "telephone," and numerous interferences had been declared and considered by the Patent office. Gray, Edison, Dolbear and others, had either claimed for themselves, or others had claimed for them, priority of invention and discovery, and Bell had thus far been sustained as against them all. Blake had perfected his microphone apparatus, and Bell's patent had become a great commercial success. The People's company either began or threatened to begin operations under its charter, and on the 20th of October, 1880, the Bell company brought suit against it in the Circuit Court of the United States for the Southern District of New York, to prevent any infringement of the Bell patent.

The People's company began taking depositions on the 19th of April, 1881, but Drawbaugh himself did not appear as a witness until December 7th, 1881. After that time others were examined, and when the proofs were closed, between three and four hundred witnesses had been produced whose testimony was taken and put into the record to establish the priority of Drawbaugh's invention. This testimony, as is now claimed, shows the story of that invention to have been as follows:

Early conception and experiments with a continuous current, 1862 and 1866 and 1867.

Tea-cup transmitter and receiver, 1866 and 1867.

Tumbler, tea-cup and mustard can, F and D, 1867 and 1869.

Improvement on B, namely, C, 1869 and 1870.

Further improvements on C and the more perfect magneto-instrument I, 1870 and 1871.

Mouth-piece changed to centre and adjusting-screw inserted (Exhibit A), 1874.

D and E, perfectly adjusted and finished magneto-instruments, January and February, 1875.

L, M, G and O, February, 1875, to August, 1876.

H, August, 1876.

J, N and P, 1878.

This statement of the Drawbaugh claim we have quoted from the brief of counsel appearing in his behalf, and his success in the litigation has been based, as we understand it, both in the answer and in the argument, on the truth or falsehood of what is thus set forth.

The letters F and D, &c., in the statement, refer to exhibits in the case, being certain instruments claimed to have been made and used by Drawbaugh in the progress of his work, and preserved until now. The original tea-cup instrument was not produced, but Drawbaugh gave in his deposition what he said was a drawing showing how it had been constructed. F, B, C, D, I and A were neither of them in a condition for use when they were put in evidence, and none of the witnesses, except Drawbaugh, could tell how they were originally constructed, or what the process was by which sound was transmitted when they were used. All that any of the witnesses could say on that subject was that they had used one or more of the different instruments at Drawbaugh's shop, and heard sounds and sometimes words spoken to them, and that Drawbaugh told them the sound was carried on the wire by electricity. There was nothing whatever produced in print or in writing on the subject, nor even a memorandum or drawing of any kind, and there is nothing in the testimony to show that Drawbaugh ever told any one how his earlier instruments were made, or what his process was, until he was called as a witness in December, 1881, and explained it in his testimony. This was nearly twenty years, according to the present claim, after he had begun his experiments, nearly seven years after he had made and used D and G, perfectly adjusted and finished magneto instruments, more than five years after L, M, G, O and H had been constructed and connected in his shop, if his story is true. It was also nearly six years after the date of Bell's patent, more than five years after the success of his discovery had been proclaimed at the Centennial Exhibition in Philadelphia, four years after his invention had gone into public use, three years after it had become an established success, and two years after he had brought the first suit for the establishment of his right against Dowd, who represented the Western Union Telegraph Company, to a successful termination.

Under these circumstances it becomes important to consider the conduct of Drawbaugh, in reference to his alleged invention, during his twenty years of eventful history, as connected with the discovery and use of the telephone. If his present claim is true, his experiments began almost as far back as those of Reis, and he had in his shop at Eberly's Mills, within three miles of Harrisburg, telephones that were substantially perfect months before Bell (on the 2d of June, 1875), got the clue to his subsequent discovery. It is conceded that D and E, claimed to have been made in February, 1875, are substantially as good magneto instruments as any Bell had used before December, 1881; and L, M, G, O and H, all of which were constructed, it is claimed, between February, 1875, and August, 1876, are as good, or nearly as good microphones as those of Blake, which were not invented until 1878. This is the theory of Drawbaugh's defense, as set forth in the answer and in the argument, and by it his case must stand or fall.

The claim is that the discovery of the process was complete, and that perfect telephones had been made and were in a condition for actual use a year and more before Bell got his patent.

DRAWBAUGH'S BEHAVIOR—ITS INCONSISTENCY WITH HIS CLAIMS.

Drawbaugh was, when he gave his deposition, 54 years of age, and had lived all his life at or near Eberly's Mills, a small village near Harrisburg. He was a skillful and ingenious mechanic, and if he made D and E, and the instruments which came after them at the time it is said he did, he had good tools and good material in 1875 and 1876, and was capable of doing the best of work. He was also somewhat of an inventor, and had some knowledge of electricity. According to the testimony he was an enthusiast on the subject of his talking machine, and showed it freely to his neighbors and people

[*Continued on Page* 6.]

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We ask our readers' attention to the few of the many fraternal compliments the REVIEW has received. The kind words from our esteemed electrical contemporaries are particularly gratifying.

The whole Union sincerely mourns the death of that able, learned and upright Judge, Morrison R. Waite, Chief Justice of the U. S. Supreme Court. His last official act was the writing of the decision in the telephone cases, his death occurring from pneumonia the Friday morning following.

Another automatic telephone system has been invented; this time by Prof. Elisha Gray, of Chicago. It is to do away with the telephone operator, and every subscriber is to be enabled to put himself in communication with every other patron of the exchange. This is not the first work done in this direction, Mr. E. T. Gilliland having perfected a system by which 25 subscribers constitute an exchange, and call up each other.

The wide awake and progressive mining companies and individuals engaged in the abstraction of the precious metals from their ores are beginning to see a great friend and ally in the electric current. The especial advantage is the transmission of power. The ore deposits are seldom so situated that it would be profitable to set up a stamp mill or concentrators on the spot; hence the ore is mined and sent to the distant points in its crude state. But by the use of a generator, at a point generally to be found within a few miles, where water power or fuel can be had cheaply and a line to the mines or workings, one or more electric motors can be used to drive such machinery as will reduce the crude material to the smallest possible bulk for convenient and cheap shipment to the smelters. Thus electricity is entering another new field, and giving promise of great success therein.

We are sorry to see our progressive and esteemed contemporary *Industries* falling into the old fogy fallacy which lies in its comment on a proposal to put 800 arc lamps in the streets of London. After some figuring to show the probability of a "nigger in the wood pile" concealed in the proposal, our contemporary says: "And the question remains, whether arc lighting in any shape or form would be an improvement upon the present system of gaslighting." That must surely have been a slip of the pen. It is not a question of relative cost; there can be no comparison between a gas lamp and an arc light—there is no relationship. As the world moves on and our cities grow richer and richer in the values of contained property, everything must keep pace with the advance. We must have above all better protection to such property; our police have to be increased to repress the criminal classes, whose temptations grow with the growth of wealth. In the days when gas was made a reliable means of lighting city streets, it was adopted, not because it was as cheap as the tallow dip or coal oil lamp, but because it was a better light; *ergo* a better protection. The criminal could not ply his vocation quite so freely. And now when we can fill our streets at night with almost the blaze of day, are we to cling to the glimmering gas lamps and crime-cloaking byways, because forsooth the blaze of electric light cost a little more than the glimmer of gas? By no means. We must incessantly advance. Progress is essential to human happiness and contentment. Our gas interests need not suffer, but rather gain. Electric lighting in this country has over and over proved this. The more light there is in the streets, the greater the demand for indoor illumination. As a matter of morals, too, the electric light has proved its efficiency as a reformer. Its status in this respect is best explained in the report of a police authority, who said: "One arc lamp judiciously placed is as good as a policeman." Almost the whole world recognizes this fact nowadays.

THE SUPREME COURT'S DECISION.

We briefly announced the long looked for decision of the United States Supreme Court in the telephone cases in our last issue, and publish complete decision this week. It is, as was confidently hoped and expected, a sweeping vindication of the claims of Alexander Graham Bell as the first inventor of the speaking telephone. This is the end of a long, arduous and costly struggle, extending over a great number of years, involving the examination of many hundreds of witnesses, and careful, learned and elaborate arguments by counsel on both sides.

Summed up briefly, the court of last resort, from which there is no appeal, decides absolutely that Alexander Graham Bell justly received and has a clear title to a patent on the art of transmitting speech by means of electricity according to any method now known; that he made a discovery as well as an invention, and that none of the claimants have in any way proved any prior claim to anything that was granted to him by the United States Patent Office. Further, and this is something to which too much attention cannot be called, the court, after having examined all the evidence, and after giving the matter the most serious and careful consideration, declares unanimously, that Alexander Graham Bell and his attorneys did nothing in obtaining the patent which they were not clearly entitled to do, and that his and their every act was lawful, proper and honorable. Remembering how the papers of the country have harped upon the assertion that Professor Bell entered into a conspiracy with Wilbur to defraud Gray of his rights, and that he and his attorneys have been openly and repeatedly charged with deliberate theft, it is a matter of congratulation that the Supreme Court of the United States has seen fit to give ample time to the investigation of the subject, and to state its conclusions with such absolute clearness and confidence. "Alexander Graham Bell," said Judge Pardee in the New Orleans decision, "is an honest man with clean hands," and this sententious affirmation is now endorsed by the unanimous voice of the court of last resort.

Volumes have been written to prove that Philip Reis invented the speaking telephone. Over and over again have we in these columns refuted the arguments of those who sought to prove this, and for years the evidence which showed exactly what Reis did and did not accomplish, has been within easy reach of any one who cared to inform himself in the matter. The assertion of Judge Waite adds nothing to the information which has long been at hand. It merely gives to it the force of law. Reis never had a speaking telephone, and never claimed to have a speaking telephone. This is the sum and substance of what the court has to say.

A very considerable portion of the decision is devoted to a consideration of the Drawbaugh pretentions. Upon this point alone was there any dissent. The opinion of the court, as formulated by the chief justice, is practically a reaffirmation of the decision of Judge Wallace. "To hold," says the court, "that Drawbaugh did discover the art of transmitting speech before Bell did, would be to construe testimony without regard to the ordinary laws that govern human conduct." Perhaps the exact conclusion which must be inevitably reached from an examination of all the evidence in the Drawbaugh case, could not be more precisely or tersely put.

Prof. Dolbear comes in for no mention at all. The affirmation of the fifth claim, the first to be considered by the court, and the most important one involved, wipes him out absolutely. It leaves him with his device, his so-called non-magneto transmitter, which may or may not infringe the Bell patent, but he is utterly powerless to use it, because the moment he does so he infringes the rights of the Bell Company under the fifth claim. The Dolbear people have had great hopes that the decision would be otherwise, and to be passed over with practically no mention must indeed be humiliating.

As has already been said, the decision on the Drawbaugh pretentions is not unanimous. Justices Bradley, Field and Harlan are of opinion that Drawbaugh did invent the telephone earlier than Bell. They base their opinion upon the volume of evidence going to show that as early as 1869, Drawbaugh in his shop at Eberly's Mills, did have an instrument which did talk, and this through the agency of a variable electrical resistance. They seem to have overlooked the fact that later on, when instruments said by Drawbaugh to be exact reproductions of the instruments used in 1869—the originals having disappeared—and made under Drawbaugh's own supervision by the best electrical mechanics that could be found, when operated, or said to be operated, in the presence of the court by the best electrical experts that the Drawbaugh crowd could find, utterly and absolutely failed to talk. It is fair to presume that at the trial Drawbaugh knew more about the transmission of speech than he did in 1869, and that in making these reproductions of the original "tin-can" and "tumbler" transmitter, which he claimed to have used in that year, he made them at least as good as were the originals. But they did not talk then, and they have never talked since, and when it came to a pinch the experts employed by the Drawbaugh people admitted that nothing more than sound could be transmitted by them. Drawbaugh's claim in the suit brought against him was, that he *fully understood and appreciated the value and importance of his alleged invention*, and that he strained every nerve to get money wherewith to perfect it and put it upon a commercial basis. This falsehood was exploded when Mr. Storrow proved that during this period of alleged extreme poverty, he received considerable sums from time to time which he used for paying off debts, repairing and improving his premises, and presenting money to his father in generous sums as a mark of filial affection.

But the dissenting judges *do not agree with Mr. Drawbaugh*. Their view is that, being a simple-minded countryman, Drawbaugh had no conception of the value or importance of his invention, the nature of which, according to the cloud of witnesses who appeared in court, was generally and familiarly known, not only in the village in which he lived, but in many surrounding towns. It would seem as though a man of ordinary intelligence, or at all events of sufficient intelligence to practise as a patent solicitor, ought to know better in what estimation he held a particular invention at a particular time than any three justices of the Supreme Court, or than the whole of them, for that matter.

It need hardly be said that the Drawbaugh people still have hopes. Drawbaugh's application for a patent, filed July 21st, 1880, is still in the Patent Office, seeking to be put in interference with Edison. So far it has failed to receive even this slight recognition, for the Edison carbon transmitter having been used by Henry Bentley and others as early as March 25th, 1878, and having been continuously used publicly from that time to this, its public use ante-dates Drawbaugh's application by two years and four months, which, under the law setting up the two year limit, excludes Mr. Drawbaugh from any consideration at the hands of the Patent Office. Nothing but an Act of Congress can give him any standing.

We desire to extend to all of our telephone friends our most hearty congratulations upon the outcome of this long and tedious contest. Subjected to constant and reiterated misrepresentation and abuse in the daily press, which somehow seems to have been only too ready to take up the cudgels in behalf of every new claimant, they have fought their way steadily and persistently, and now have their reward in the judgment of the highest tribunal in the country. Perhaps it is too much to hope, but it does seem as though the telephone business throughout the country might now be permitted to pursue its work in peace. But starting infringing telephone companies and selling stock to the public has been too remunerative to be given up absolutely. The lambs are still bleating on the hillsides, waiting to be shorn.

It may be well to mention that the Government suit, now almost forgotten, is practically settled by the decision of the Supreme Court. Even should it come to trial by a reversal of the decision of Judge Holt on the demurrer, every question involved has been settled in favor of the Bell Company by the opinion rendered on Monday, March 19.

OUR CHICAGO LETTER.

(Special Correspondence.)

The T.-H. Co. recently purchased the entire motor business of the Van Depoele Electric Manufacturing Co., of Chicago. It is understood that Mr. Van Depoele will remove to Lynn, or some other Eastern locality, where his energies are to be devoted to the interests of the T.-H. Motor Department. While all Chicago's electrical people will be sorry to part with Mr. Van Depoele, all will rejoice that he will be enabled to pursue some one branch of electric work, and discard all others. The Chicago Company which bears his name, too, will now be enabled to concentrate its energies and push the matter of electric lighting more thoroughly. There is an old proverb about too many irons. Only the American rights were acquired by the T.-H. Co., and the additional capital now acquired by the Van Depoele Co., of Chicago, will make it a lively competitor with other dynamo and lamp manufacturers.

The discussion on Mr. M. M. M. Slattery's paper before the Chicago Electric Club was opened by Mr. Sperry immediately after Mr. Leonard's motion, which was unanimously adopted, that a vote of thanks be extended to Mr. Slattery.

Mr. Sperry said that he had seen nothing to change his mind relative to the advantages of the alternating system, but failed to see how the number of convolutions would bear on the case, save as to cost of labor.

Mr. Slattery said, apologetically, that he had not yet finished some determinations he was engaged on, but hoped soon to give them to the Club. The convolutions of wire on the armature were reduced to a minimum to prevent inductive reaction. He thought 1,000 volts as high as present perfection in insulation would warrant.

Mr. Sperry had noticed that at Pittsburgh the primary wire insulation was heavier than that on the secondary, and was water-proofed.

Mr. Slattery read a letter from Prof. Geo. Forbes, regretting he was not permitted to be present to hear the discussion on the paper, which he had read. He indorsed the conclusions arrived at. He had no hesitation in publicly stating that if an ordinary continuous current motor be made with laminated field magnets, it will work with alternating currents economically and efficiently at any required speed.

Mr. Leonard said he was disappointed that the points in his paper had not been discussed more generally, so that some comparison of the two systems could be instituted. The figures he presented were simple and could be readily criticised. If they were incorrect, it might be shown, and it would certainly be a strong point for the alternate current advocates. During the present ruling rates on copper, prices were, of course, against low current systems, but he thought this corner would not eventually affect the question materially. As to the opinion of English scientists on the question of saving, in first cost as between two and three wire systems, it had frequently been stated across the water that the saving was but 25 per cent., while it was in fact 66 per cent.

Mr. Slattery had quoted the expression "dragging," which was already a quotation, when he, Leonard, used it. The point of comparative depreciation, a fundamental one, had not been mentioned in the paper read. The reliability of operation, too, was ignored. As the paper he had read was based almost on the figures presented, and as these had not been criticised, Mr. Leonard did not feel that the vital points could well be discussed.

Prof. Badt didn't care to enter very deeply into the discussion just now, as he was shortly to read a paper now being prepared. He regretted that Mr. Slattery drew the line at 1,000 volts, because of distrust of our insulating friends. In Europe, 1,800 and 3,800 volts are used. Either their wire is better or the curse of the age, undertaker's wire, clings to us still. We can go ahead, and our insulating friends must get ready to keep up with us.

Mr. Slattery had not had time to go into details sufficiently. He hoped to come before the club again, and show up the inaccuracies of Mr. Leonard's statements. Thought he had touched upon each of the points presented by that gentlemen, but not as completely as he would wish. Two months ago he had taken a converter down that had been in use over two and a half years. There was no evidence of deterioration whatever.

Mr. Cutter (Thomson-Houston)—I think I appreciate the point. Mr. Leonard asks us to compare $1,000 worth of copper twenty years hence with $1,000 worth of converters. Mr. Cutter drew mental pictures of an aerial Edison 3-wire system, and a converter system on fully equipped poles, and asked comparative mental estimates of the cost of maintenance. The cost of the converter is largely that of labor, and the construction such that it favors repairs. Armatures may burn out, but he thought that a mere mechanical defect, easily to be remedied. He alluded to the Thomson (Elihu) suggestion of grounding the secondary wires. The plan he thought good.

Prof. Badt asked Mr. Haskins how he would test such lines?

Mr. Haskins said it was said that God took care of His chosen people, and he did not fear but that when the time came for him to test such circuits, some way would be provided.

Mr. Slattery said that a novel idea which did away with grounding the secondary had been adopted by him, which consisted in placing a grounded neutral band between the primary and secondary, so that an escape to ground through the secondary would be impossible.

A discussion arose as to whether this relieved the electric strain on the insulation of either primary or secondary, which Mr. Slattery claimed. Cutter, Warner, Sperry and Badt taking part in the contest, each in turn ignoring the chair, and trampling ruthlessly on parliamentary rules.

Prof. Badt finally brought the matter to a close by a remark that he was sorry to see the allies giving away their arguments in an indirect discussion. C. C. H.

Chicago, March 26, 1888.

Electric Clublets.

The Club now has a membership of 427.

Peter Cooper Hewitt, a son of the Mayor, is a rising young engineer, takes much interest in electrical matters, and is a member of the Club.

Mr. C. J. H. Woodbury, of Boston, was a guest of the Club over night last Thursday. Non-resident members are very generally appreciating the convenience of the Club House as a stopping-place.

Mr. Geo. L. Phillips, president of nearly all the telephone companies in the west, is a New York visitor, having found it possible to leave Chicago in other, if not so safe, hands for a few days. His headquarters are at the Murray Hill and the Electric Club.

Emperor John I. Sabin telegraphed from San Francisco for accommodations at the Club, where he will make his headquarters during his Eastern visit. Friday of this week he is expected to arrive, and will remain to exercise the right of suffrage at the annual election. Mr. Sabin is the most distant resident member (under the Club constitution). The membership list includes Major F. W. Jones, of South America and London, who is the farthest away member of the Club. He is in New York at the present time, officing with Mr. O. E. Madden, at 18 Cortlandt street.

Mr. W. B. Clarke, of Kansas City, Mo., was a Club visitor last week. Mr. Clarke, in addition to being president of a leading bank of his city, takes an active interest in the telephone business, was formerly president of the Missouri & Kansas Telephone Company, and is now a director and large stockholder. The Kansas Club, an entirely social organization, of which Mr. Clarke is vice-president, has recently moved into very fine quarters, but Mr. Clarke admits it is not equal in one respect to the Electric Club—in point of light.

There is no doubt but that the Electric Club is the best lighted building in the world.

OUR OBSERVING CONTEMPORARIES.

The Fraternal Greeting the Improved "Review" Receives in their Columns.

"IT SETS AN EXAMPLE."

[*From the N. Y. Herald.*]

The ELECTRICAL REVIEW inaugurates its thirteenth volume with a new cover from which advertising is banished. In this it sets an example to the more distinctively literary publications. It is needless to add that its interior evinces corresponding evidences of taste.

"WELL-EDITED AND ABLE."

[*From the N. Y. Tribune.*]

The ELECTRICAL REVIEW, of this city, which is now entering its thirteenth volume, celebrates the event by appearing in a new and striking cover, and giving its readers several new departments, covering new fields in which electricity is becoming an important element. The REVIEW is a well edited and able paper.

"A MIGHTY PAPER."

[*From the Electric Age.*]

The ELECTRICAL REVIEW makes its appearance this week, uniformed in a cream-colored cover, which is extremely appropriate and becoming and adds greatly to the appearance and value of our esteemed contemporary. Brother Worthington has wonderfully sound judgment as to what the contents of a popular electrical journal should consist of, and invariably furnishes his constituents with a paper which, when once it is taken up, cannot be laid aside until the entire contents have been perused. The ELECTRICAL REVIEW has developed into a mighty paper during the past three years, and its influence is felt wherever electricity is known. May it continue to prosper and develop under the safe and sure guidance of Brother Worthington and his able assistants.

"DESCRIPTIONS OF MANY IMPORTANT ELECTRICAL ENTERPRISES."

[*From the N. Y. Daily Graphic.*]

The ELECTRICAL REVIEW, entering its thirteenth volume, comes out this week with a decided change in its appearance. A cover, with a striking front—on which no advertising matter is permitted—has been added, as well as several new departments intended to more thoroughly represent and classify the new fields in which electricity is becoming an important element. In this issue appear illustrations and descriptions of many important electrical enterprises, notably long-distance telephoning and incandescent lighting on a very extensive scale, besides numerous scientific and practical articles grouped under appropriate headings.

"A DECIDED INCREASE IN SIZE AND ATTRACTIVENESS."

[*From the Boston Herald.*]

The ELECTRICAL REVIEW, of New York, marks the beginning of its thirteenth volume by a decided increase in size and attractiveness. Six pages and an attractive cover have been added. The front page of the latter is striking in appearance and free from advertising. Several new departments have been added. * * * * Illustrations and descriptions of many important electrical enterprises, notably long-distance telephoning and incandescent lighting on a very extensive scale, make this number of especial interest.

"A CORRECT MIRROR OF ELECTRICAL AND SCIENTIFIC PROGRESS."

[*From the Topeka, Kans., Daily Capital.*]

The *Capital* is in receipt of the ELECTRICAL REVIEW, a weekly journal published in New York, which has taken front rank among the scientific publications of the country. It is a correct mirror of the progress that has been made in the electrical and scientific world.

"IT DOES NOT REQUIRE RED INK OR BUNCOMBE TO ATTRACT ATTENTION TO ITS MERITS."

[*From Modern Light and Heat, Boston.*]

Last week's number of our contemporary, the ELECTRICAL REVIEW of New York, was a welcome surprise to our sanctum. Encased in a handsome cover, of tasteful design, new type throughout, additional departments for the classification of news, and printed on paper of excellent quality, it positively charmed us. We salute you, most worthy and honorable competitor, and at the same time give a hearty Amen to your modest editorial reference of progress. There is no *bragadocio* about it, but plain facts. And expresses most correctly and honestly the sentiments which have shown the high esteem with which the ELECTRICAL REVIEW is everywhere regarded, and which, in connection with the very liberal business recognition it receives, has only been gained through the highest standard of newspaper conduct and integrity and the practice of legitimate and honorable business principles. The REVIEW has always occupied a prominent position in every advancement made in electrical science. Its editorial utterances have been able, independent and fearless, and it has disseminated, regardless of cost, the investigations and experiments of the best minds, and faithfully and intelligibly chronicled each step of progress made in electrical research. It does not require the use of *red ink* or *buncombe* to attract attention to its merits. We again salute you, Brothers Worthington and Price, and wish you long life, and the ELECTRICAL REVIEW continued success.

"THE BEST PAPER."

[*From the Lowell Mail.*]

The best paper for persons interested in electrical science is the ELECTRICAL REVIEW, of New York. It is a 24 page paper, and appears the present week in a new dress and a general appearance of prosperity that speaks well for its managers.

"IN THE FRONT RANK."

[*From the N. Y. Journalist.*]

They have put the ELECTRICAL REVIEW, published at No. 13 Park Row, New York, in the front rank of technical newspapers. Its issue of March 17 was a revelation of typographic beauty and scientific progress. *The Journalist* wishes its very successful neighbor all the good fortune which is hidden by the veil of years yet to be.

"ABLE AND ENTERPRISING."

We publish the following from one of many scores of letters received. This one is from a Boston gentleman of discernment, and, it is needless to say, of most excellent taste and judgment:

I wish to add my tribute to the many which, freighted with congratulations on the beautiful "spring suit" in which the ELECTRICAL REVIEW has blossomed out, will surely find their way to P. O. Box No. 3,329.

The clean and attractive outside gives promise of something good to be found within, and well is the promise kept.

Certainly you and your associates in both the editorial and business departments may well be proud of the current number of your paper, and you may feel sure of the best wishes of your many friends.

Personally, I heartily congratulate you, and I may add that the entire electrical fraternity can but feel gratified that there should be devoted to its interest so able and enterprising a journal, as the early report of the Electric Light Association meeting at Pittsburgh and the current number prove the REVIEW to be. May it "live long and prosper."

"TRUE AND RELIABLE EXPONENT."

[*From the Fireman's Herald.*]

A cover with a striking front, on which no advertising matter is permitted, has been added, as well as several new departments intended to more thoroughly represent and classify the new fields in which electricity is becoming an important element. A twenty-four page paper, exclusive of cover, is found necessary, without padding or extra effort, to comprehensively represent the very active field of which the REVIEW aims to be the true and reliable exponent.

"IT IS A TRUE AND RELIABLE EXPONENT."

[*From the Leather Gazette, St. Louis.*]

The ELECTRICAL REVIEW, on entering its 13th volume, comes out in a very pretty new spring dress of buff with black trimming and electrical ornaments. The REVIEW was alway a neat dresser, but the present costume equals that of a young lady making her debut in society. On entering its new volume the REVIEW has made some marked improvements in the adding of several new departments intended to represent and classify the new fields in which electricity is becoming an important element, and of which science it is a true and reliable exponent.

"THE PROSPERITY DUE ACTIVITY AND ENTERPRISE."

[*From the Western Electrician.*]

Our esteemed contemporary, the ELECTRICAL REVIEW, of New York, has donned a new spring dress in the form of a cover, and takes occasion to utter words of self-gratulation. We cordially wish for our contemporary the prosperity that is due activity and enterprise.

"FAR IN ADVANCE OF ANY PUBLICATION ISSUED."

[*From the Boston Commercial.*]

The ELECTRICAL REVIEW came out this week in a handsome cover and an entirely new dress of type, which adds very materially to its heretofore attractive appearance. This publication is the very best of its class. Its typographical appearance and the excellence of its illustrations are far in advance of any publication issued, either in this country or in Europe—not excepting the Illustrated London *News*, nor *Graphic*. The REVIEW is a pronounced success in every sense, editorially, typograpically, artistically and financially.

St. John's College, Fordham, N. Y., is being fitted up with an incandescent system. The United States is used.

The Van Depoele motor system has been purchased by the Thomson-Houston Electric Company. This makes a strong motor combination, comprising the Thomson-Houston, Bentley-Knight and Van Depoele.

Mr. Fred. A. Gilbert, for the first time in many months, tore himself away from Boston long enough to spend one day in New York. As a member of the Board of Managers, who had been absent from every meeting, he deemed it about time he should inspect the work done at the Electric Club. He did so, and passed a most favorable opinion.

TELEGRAPHIC

.... An Albany horseman was speeding his trotter the other day when the horse cast a hind shoe, which flew with such violence from the hoof that it went high in the air and caught on a telegraph wire, where it hung until some boys got it down.

.... The stockholders of the Commercial Cable Company re-elected the trustees who served last year, and they re-elected the following officers: John W. Mackay, president; Hector De Castro, vice-president; C. C. Broun, second vice-president; E. C Platt, treasurer, and George G. Ward, secretary and general manager.

Tensions of Telegraph Wires at Various Temperatures.

Starting from the equation to the catenary, and taking into account the increase of length due to increase of temperature, as well as the change in length proportional to the change of tension due to the elasticity of the wire, the author has calculated a table which shows the relation between the factor of safety, the tension for wires of 3, 4 and 5 mm. diameter, the sag, and the temperatures corresponding to stretches of 60, 70, 80, 90 and 100 metres.

Suppose a wire 5 mm. in diameter, with a stretch of 80 metres, the tension at zero is 156 kilogrammes; then for any other temperature, say 16° C., we find the co-efficient for multiplying this tension is 0.83, the tension is 130 kilogrammes, and the sag is 0.96 metre; for a stretch of 100 metres the tension would be 136 kilogrammes, and the sag 1.44 metre.

The Telephone and the Public.

[From the N. Y. *Sun*.]

The fact that the judgment of the Supreme Court in the Bell cases was finally expressed by a vote of four judges against three, still stimulates journals of such character as the *Times* in the attempt to create an impression that there is doubt respecting the validity of the telephone patent, and that the President should continue the effort to break it down.

For the benefit of those who may have come under the influence of such reasoning, the case of the Department of Justice, or, to put it in broader terms, the case of the Administration against the telephone, was tried and considered fully in the recent decision, and the judgment in favor of the patent was not by a vote of 4 to 3, but by a vote of 7 to 0. The court was unanimous.

The Executive suit to take away the patent from Bell, rested upon these two assertions:

That Reis invented the telephone.

That Bell committed fraud in obtaining the patent.

If Reis invented the telephone, of course, Bell's claim must be wiped out, and then the principle of the thing would be thrown open to the public. This assertion, together with the theory of fraud, were the foundations of antagonism to the patent and the grounds for the President's attempt to overthrow it.

Upon both of these points the court were unanimous. The decision was by 7 to 0 that Reis had failed to discover the essential principle, and by 7 to 0 also that the Bell patent was untainted by fraud, and that Gray's assumptions and allegations were groundless. So far as popular right in the instrument goes, and so far as reasons for the President's assailing the patent are concerned, the decision shows the full front of the court in favor of the patentee.

After defining the relations between the people and the telephone, Justices Bradley, Harlan and Field, go on to say that as between Bell and Drawbaugh they favor the latter. That means that in their judgment we should now be using the Drawbaugh telephone instead of the Bell; but the change, so far as the public is concerned, would be a change in name only. And probably a telephone by any other name would cost about what it does now.

[*Continued from Page 3.*]

from the country whenever they visited his shop.

The Centennial Exhibition was opened in Philadelphia in May, 1876. Drawbaugh visited it on the 17th of October, 1876, remaining four or five days. Before he went he had heard, as he says, that some one besides himself had invented a speaking telephone, which he had the impression was on exhibition there. If what he now claims is true, he had then on hand in his shop, Exhibits D, E, L, M, G, O and H, all of them good instruments of their kind and capable of transmitting speech, and some of them but just finished. Bell's apparatus had been exhibited to the Board of Judges in June before, and had attracted marked attention. The matter was much discussed in the public press, and yet it never seems to have occurred to Drawbaugh to take any of his telephones with him when he went, although they were small in size, and some or all of them could have been carried without serious inconvenience. When giving his testimony he was examined in chief as to that visit, and this is what he said on the subject of telephones:

Q. Did you attend the Centennial Exhibition at Philadelphia in 1876? A. Yes, sir; I did.

Q. Can you give the date on which you went there? A. I can by reference to a book. It was October, 1876. The 17th was a day on which I dated a letter from Philadelphia when I was there on that visit.

Q. How long did your visit there last? A. About four or five days, to the best of my recollection.

Q. Who went with you on that visit? A. Mr. George Leonard.

Q. Was that the only visit to the Centennial Exhibition that you made? A. Yes, sir; it was.

Q. At the time that you went there, or before that time, had you heard that somebody else besides yourself had invented a speaking telephone or a telephone? A. Yes, sir; some time before that. I don't remember how long, but not a great while.

Q. When you went there, did you suppose it would be on exhibition there? A. I don't remember whether I had heard that it was on exhibition or not, but I got the impression some way that it was on exhibition.

Q. While you were there at the Centennial, did you see any telephones or make an effort to see any there? A. Yes, sir; I made an effort, and seen an instrument called a telephone, and supposed it to be the instrument spoken of; the one of which I had heard. I was looking, and had made some inquiry, and was directed or came to a portion of the building where I saw on a counter some man's telephone; the name I don't remember. At that time, or several times that I called, there was no one there to attend to it. I spoke to another party that had something else on exhibition. I don't recollect what it was, just near by, and I asked him whether there was any one there to attend or show the instruments. I was informed then there was no one there to show them.

Q. If you remember, please state what kind of an instrument it was that you saw there, and state what information you were able to obtain there regarding it and its mode of operation? A. There was a number of instruments placed on to a raised portion, something like a shelf; that is, it resembled something like pigeon-holes, a box open in front, and each instrument at the back of it had an electro-magnet. The number of instruments I don't remember. I don't remember of counting them. If I am not mistaken there may have been a dozen or more. Perhaps some were larger than others. I can't give you a much better description than that. I couldn't get any information about them. This attendant made some remarks about the instruments, but he didn't understand them and couldn't explain them. I was several feet from where the instruments were. They were on a raised place like a shelf, just about high enough for a man to speak into. That is the way it looked to me. I didn't go in behind the counter to examine them.

Q. Did you see any circulars lying around there referring to these instruments or any advertisements of them? A. I don't remember about that. It may have been.

Q. What was your impression as to the character of the instruments when you finally left them? A. I was impressed with the idea that they were instruments to telegraph by sounds, a certain sound to represent a certain letter of the alphabet. I am not certain how I got the idea, or whether any person told me that at the time, but that is the idea that I had.

Q. Do you know whether that was Gray's harmonic telegraph that you saw there or not? A. It didn't say "telegraph." I am confident it was called telephone. I didn't see the working parts of the interior except the electro-magnets. I took the name of the man and his address on a piece of paper and put it in my pocket, but I don't know what became of it. I don't know whether it was Gray's harmonic telegraph or not.

Q. Did you see any tuning-forks about it? A. I did not.

That was all he did during his entire visit to ascertain whether any one besides himself had actually entered upon this new and interesting field of invention and discovery. He spoke to no one about what he had done himself. He made no special effort to find out whether that which was on exhibition was in any respect like what he had at home; neither did he when he got home, so far as the record shows, say anything to his neighbors or visiting friends about what he had seen or heard. He had apparently lost all interest in talking machines.

Not so, however, with his other inventions. The testimony shows that during the early part of 1876 he was much occupied in building an electric clock which he thought of exhibiting at the Centennial. This he did not do, however, but several days before he went to Philadelphia, or soon after, Rufus E. Shapley, a jeweler of Mechanicsburg, went on his suggestion to Eberly's Mills to look at the clock which he had made. Soon after that the clock was taken to Shapley's store in Mechanicsburg, and on the 8th of November, 1876, Drawbaugh, by an instrument in writing, transferred to Shapley a one-half interest "In the clock I am getting up, the said Shapley to pay for patenting the same." Shapley had then $2,000 in money, which Drawbaugh was anxious to have him invest in this business. The clock was taken by him to his shop so that it might be examined with that end in view, if it should prove to be useful. Some time afterwards it was taken back to Eberly's Mills, where it remained until April 1st, 1878, or thereabouts, when a clock company was formed, and this clock, or another one substantially like it, was taken about the country for exhibition. For this, Drawbaugh was paid $500 and an interest in the profits.

On the 20th of September, 1878, he applied for a patent for improvements in batteries for electrical clocks. The patent was issued January 14th, 1879, to the members of that clock company. The enterprise does not seem to have been productive of any very great success.

In November or December, 1878, while this clock was on exhibition, Drawbaugh was introduced to Edgar W. Chellis. He had with him at the time a wooden model of a faucet that he wanted Chellis and another man to take a one-third interest in. An arrangement was made by which Chellis got a two-thirds interest, he paying $250 for it January 7th, 1879. On the 14th of the same month, Drawbaugh filed in the Patent Office an application for an improvement in rotary measuring faucets. After this application an interference was declared, March 27th, 1879, between Drawbaugh and David A. Hauck, who had filed an application. In his prelimary statement in this interference, Drawbaugh said he had conceived the idea of his faucet in the fall of 1869, and made a working model in 1877, and the Patent Office model was not completed until about the 1st of November, 1878. The case was closely contested, and finally decided in favor of Drawbaugh, January 15th, 1880. The patent was granted to him and Chellis July 6th of the same year. In this contest, Jacobs and Hill, who afterwards became interested in the telephone claim, appeared as the counsel for Drawbaugh.

On the 2d of July, 1879, Drawbaugh filed another application in the Patent Office for an improvement in water motors. Chellis was to have in this also a two-third interest. On this application a patent was issued March 16th, 1880.

It is impossible to believe if Drawbaugh had in his shop, when he reached home from the Centennial, exhibits D, E, L, M, G, O and H, or even D and E alone, that he would have set himself to work in the first instance in developing the clock enterprise or perfecting his former conception of the measuring faucet, instead of calling attention to his great discovery of the telephone, which he was in danger of losing by a patent which had been issued to another, and which he could not but have known was even then attracting the greatest attention. In this connection it must be kept in mind that the theory of the defense, as stated in their answer is, that Drawbaugh had at that time fully perfected his invention, and that while at first "he conceived that its range and capacity for usefulness to the public might be very greatly enlarged," he had before the date of Bell's patent, "notwithstanding his impoverished and embarrassed pecuniary condition and his utter want of proper mechanical tools," finally perfected his work. His conduct, therefore, is to be judged, not as of one who was still in the midst of his experiments and doubtful as to the results, but as of one who had arrived at the end, and completed his success. No man of his intelligence, with or without the enthusiasm on the subject which it is said he possessed, could remain silent under such circumstances.

As we have read the testimony, it is not even pretended that he took any of these instruments outside of his own village until May, 1878, when, as is claimed, he showed one to his friend Stees, in Harrisburg, whom he had known for years, who was the first to use, and in fact was then using, a Bell telephone upon a private line of his own between his office and his shops. This produced no results; and when afterwards, in January, 1879, Chellis was told that Drawbaugh had a phonograph and a telephone that he had invented, he gave it no attention, because, to use his own language, "I was interested in the faucet and motor business and wished to push them, and I did not think we could do much with a telephone, as Bell had a patent and I did not know that he could antedate it."

Again, when speaking of a conversation he had with Drawbaugh, he said, "I advised him to drop the telephone, as he could not antedate Bell." He said he didn't know about that; that he had been working on it a good while. It was his way of expressing himself when I would say, "You can't antedate Bell." He would say, "I don't know about; I have been working at it a good while."

This, it must be remembered was in 1879, after the telephone had become a success, and after it had been a year or more in use in Harrisburg where Chellis lived. It is impossible to believe that either Chellis or Drawbaugh was ignorant of the approximate time of Bell's invention, which had been the subject of frequent newspaper comment from the time of its exhibition at the Centennial. The subject was often referred to in the Harrisburg and Mechanicsburg papers, and it is not for a moment to be supposed that all these various articles escaped their attention. Under such circumstances, if it were true that Drawbaugh had made his D and E as is now claimed, in February, 1875, he certainly would have said so, and he would not have contented himself with so doubting an answer to Chellis' suggestion of his inability to antedate Bell, as that which Chellis now says he gave.

Another important fact in this connection is one which is proved by the testimony of Andrew R. Keifer, who from 1863 had been division telegraph operator having charge of the middle division of the Pennsylvania railroad, and resided in Harrisburg from 1893 to the winter of 1881. He was a member of an electric firm in that place, engaged in the manufacture of burglar alarms, instruments for the signal bureau, etc. He had also since 1876 kept a place for the sale of electrical supplies. He had known Drawbaugh since 1876, and probably before. Drawbaugh met him on different occasions in the course of their acquaintance and talked with him on electrical matters. In the course of their acquaintance, Drawbaugh showed him an electrical fire-alarm apparatus, and the working of his electrical clock, but the subject of telephone was never alluded to between them until the summer of 1881, when this occurred (we quote from the deposition of Keifer).

In the summer of 1881 I took my wife out for a drive and went over to see his works, never having seen them, and having promised him to come and see him some time; my wife not caring about going to the shop remained in the carriage, and I went through alone with Mr. Drawbaugh. He showed me through the shops and introduced me to Mr. Chellis, and showed me parts of the water-motor and some other things of his getting up. On account of my wife being in the carriage alone I did not stay long. As I stepped into, or was just in the carriage, Mr. Drawbaugh said: "I forgot to show you my telephone!" I did not get out again to go and see it, and I drove away without seeing it, expecting to see it again, but I have never got over to the shop since.

This was after the suit of the Bell company against the People's company was begun, and of course after the matter got into the hands of Chellis and his associates. It is no answer to the criticism of Drawbaugh's conduct in this particular to say, as was said in the argument, that one reason why he did not speak or apply to every man with whom he had a personal acquaintance was that he was ridiculed by his neighbors; that his invention was considered a humbug by them and of no commercial value. Bell's success was proclaimed in the Harrisburg *Patriot* as early as February 26, 1877, and the age of ridicule was then past. If Drawbaugh had at that time in his shop the machines it is now claimed were there, complete as they now are, in August, 1876, and most of them before, there cannot be a doubt that he would have taken them to some place where they could be tried, and show that they would do what he had all along claimed for them. All he had to do at any time after he came back from the Centennial was to take any pair of his little instruments to his friends at Harrisburg, attach them to a line wire and show what he had. They were men who could appreciate the telephone and help him, if it was, as he now says it was, a success. It would certainly have been easier then, within two years of the time the first of them was made, and within a year of the date of Bell's patent, to show that he antedated Bell, than it was three years afterwards when he was brought into the controversy through the instrumentality of his associates, not, as must be evident to all, to get a patent for himself, but to defeat that of Bell.

In this connection it is specially significant that the application which it was claimed was made for a patent on the 21st of July, 1880, and the specification of his invention which was then written out, has been purposely and designedly kept out of the case, although their production was demanded. They were written before this suit was begun, and it is impossible to believe that they would have been withheld, at least upon the call of the opposite party, if they were in all respects consistent with the subsequent development of the case. The excuse given by counsel at the time, that they were in the secret archives of the Patent Office, and if produced and published in this case, would possibly invite the filing of contesting applications and result in an interference and additional litigation, besides unnecessarily prolonging the taking of testimony and increasing the expenses, we cannot accept as satisfactory, in view of the fact that in the answer, it was said that one object of filing the application "was to procure interference proceedings to be instituted against the patent of Bell, in order that Drawbaugh might be adjudged by the Commissioner to be, as he rightfully is, the original and first inventor."

DRAWBAUGH ENTIRELY INCONSISTENT.

We have not overlooked the depositions that have been taken in such large numbers to show that Drawbaugh was successful with F, B, C, I and A, before D and E were made. They have been studied with care, and if they constitute all the evidence in the

case it would be more difficult to reach the conclusion that Drawbaugh's claim is not maintained. But in our opinion their effect has been completely overcome by the conduct of Drawbaugh, about which there is no dispute. From the time of his visit to the Centennial until he was put forward by the promoters of the People's company, nearly four years afterwards, to contest the claim of Bell, he was silent, so far as the general public were concerned; while if he had really done what these witnesses say he did, he would certainly have spoken. There is hardly a single act of his connected with his present claim, from the time he heard, before going to Philadelphia, that some one else had invented a telephone which was on exhibition at the Centennial, that is not entirely inconsistent with the idea of a complete discovery or invention by himself which could be put to any practical use.

It is not pretended that what he did was done in private. He had influential friends with ample pecuniary resources to help him in bringing out his inventions when they promised success. He easily got aid for his clock and for his faucet. The news of Bell's invention spread rapidly, and it took but a few months to demonstrate to the whole world that he had achieved a brilliant success. No one can believe that the public would be kept in ignorance of the invention until four years afterwards, when a special despatch from Washington to the *Cincinnati Commercial* announced a telephone combination to have entire charge of the telephone in this country.

DRAWBAUGH'S FAILURE TO REPRODUCE RESULTS.

But there is another fact in this case equally striking. As has already been seen, F, D, C, and I were in no condition for use when they were produced and put in evidence. They were mere remains. No one but Drawbaugh himself could state how they were made or how they were to be used. He undertook to reproduce some of them, especially F and G. This was in the latter part of 1881, while the testimony was being taken. The Bell company proposed that they should be tried, to see if they would do what the witnesses said had been done with the originals, which the remains show must have been exceedingly primitive in their character. The testimony also shows that when they were originally used, by or in the presence of the witnesses, no particular care was taken in their adjustment. They were lying around in the shop or placed upon shelves. Some say that when the experiments were made they were held in the hands or allowed to stand on a table. In order to reach satisfactory results, Drawbaugh himself said in his deposition:

I had persons in the cellar reading printed matter, some advertisement or something, and I could hear the words that were read; and at other times I would go down into the cellar and read something and come up, and they would repeat the words to me that I had read.

The proposition of the Bell company was accepted, and the reproductions were tried in March, 1882, under the most favorable circumstances. It is substantially conceded that the trial was a failure. Occasionally a sound was heard, and sometimes a word, but it would not transmit sentences. At the time of these experiments, F, which was the transmitter, was placed on a table as Drawbaugh said it was originally.

Two years afterwards other reproductions were presented, differently constructed, and used in a different way. Those would talk, but they were neither the same nor used the same way as the originals. To our minds, the result of the experiment conclusively shows that the original instrument could not have been of a construction similar to the reproductions, and that what they had done was produced by some other means.

We do not doubt that Drawbaugh may have conceived the idea that speech could be transmitted to a distance by means of electricity, and have experimented upon that subject. But to hold that he discovered the art of doing it before Bell did would be to construe testimony without regard to the ordinary laws that govern human conduct. Without pursuing the subject further we decide that the Drawbaugh defense has not been made out.

NO FRAUD BY PROF. BELL IN THE PATENT OFFICE.

Another objection to Bell's patents put forth in the oral argument of Mr. Hill, and in the printed brief signed by him, and in that signed by Mr. Dixon is, that the application as originally filed in the Patent Office, did not contain his present fourth claim or any description of the variable resistance method, and that all which now appears in the specification on that subject, including the fourth claim, was surreptitiously interpolated afterwards. Bell's application was filed February 14th, 1876, and afterwards, during the same day, Elisha Gray filed a caveat in which he claimed as his invention "the art of the transmission of vocal or other sounds or conversation telegraphically, through an electric circuit," and in his specification described the variable resistance method. The precise charge now made in the printed brief of Mr. Hill is:

That Mr. Bell's attorneys had an underground railroad in operation between their office and Examiner Wilber's room in the Patent Office, by which they were enabled to have unlawful and guilty knowledge of Gray's papers, as soon as they were filed in the Patent Office; and that an important invention and a claim therefor were bodily interpolated into Bell's specification between February 14th, 1876, and February 19th, 1876, by Pollok, in consequence of the guilty knowledge which the latter already had of the contents of Gray's caveat before the declaration of interference with Gray on February 19th.

So grave a charge, made in so formal a manner, is entitled to consideration. It involves the professional integrity and moral character of eminent attorneys, and requires us to find from the evidence, that after Bell swore to his application on the 20th of January, 1876, and after the application thus sworn to had been formally filed in the Patent Office, an examiner who got knowledge of the Gray caveat put in afterwards, disclosed its contents to Bell's attorneys, and they were then allowed to withdraw the application, change it so as to include Gray's variable resistance method, over Bell's signature and over the jurat, and then to restore it to the files thus materially altered, as if it were the original, and all this between February 14 and February 19. Although much stress was laid in the argument on the fact that was purported to be a certified copy of the specification of Bell, as found in the file-wrapper and contents printed in the Dowd case, differed materially from the patent, the occasion of these differences has been explained in the most satisfactory manner.

We entertain no doubt whatever that the specification as now found in the patent is precisely the same as that on which the order to issue was made. If any alterations were made they were all done before February 19, and the fair copy which is now found on the files of the Office is precisely as it was when the order for the patent was granted; not a shadow of suspicion can rest on any one.

At any rate, the bare fact that the differences exist under such circumstances is not sufficient to brand Bell and his attorneys and the officers of the Patent Office with that infamy which the charges made against them involves. We therefore have no hesitation in rejecting the argument. The variable resistance method is introduced only as showing another mode of creating electrical undulations, and that Bell had had his mind upon such a method is conclusively established by a letter which he addressed to Mr. Hubbard on the 4th of May, 1875, and which is in the Dowd record, introduced into the Overland record by stipulation. Its insertion in his final draft of his specifications is another proof of the care with which the work had been done.

PROF. BELL'S SECOND PATENT.

This disposes of all the cases so far as the patent of March 7th, 1876, is concerned. It remains now to consider only the other patent. It received but little attention by counsel or court in either of the cases below. In the Dolbear case it was by consent excluded from the decree.

In the case of the Clay Commercial Co. it was alleged in the answer that substantial and material parts of the things described and claimed were described and claimed in a prior British patent taken out December 9th, 1876, and inasmuch as the foreign patent does not bear the same date, if the American patent is not limited it is void. This point has not been pressed in the argument. In our opinion it has been settled by the decisions of this court in *O'Reilly* v. *Morse* and in *Siemens* v. *Sellers* at the present term, that the effect is not to render it invalid if it is for the same invention, but only to limit its term. The patent in itself is for the mechanical structure of an electric telephone, to be used with the electrical action on which the first patent rests. The *third* claim is for the use, in such instrument, of a diaphragm made of a plate of iron or steel, or other material capable of inductive action; the *fifth* is a permanent magnet; the *sixth* for a sounding box; the *seventh* for a speaking or hearing tube; and the *eighth* for a permanent magnet and plate combined. The claim is not for these several things, but for an electrical telephone in the construction of which those things or any of them are used. Hence the fifth claim is not anticipated as was decided in the Molecular case below. The patent is not for a magnet, but for a telephone of which it forms a part. To that extent the decree in that case was erroneous.

THE JUDGMENT OF THE COURT.

It follows that the decree in each of the cases so far as it is in favor of the Bell company and those claiming under it, must be affirmed, and that the decree in the Molecular case so far as it is against that company on the fifth claim of the patent must be reversed, and a decree directed to that extent in its favor. It is accordingly so ordered.

Mr. Justice GRAY was not present at the argument and took no part in the decision of these cases.

THE DISSENTING OPINION IN RELATION TO DRAWBAUGH.

At the conclusion of the reading of the opinion of the court, Mr. Justice Bradley made the following remarks:

Mr. Justice BRADLEY—Mr. Justice Field, Mr. Justice Harlan and myself are not able to concur with the other members of the court in the result which has been reached. The point on which we dissent is the question of Drawbaugh's invention. We think that Drawbaugh did anticipate the invention of Mr. Bell. We think that the evidence to that point is so overwhelming, both with regard to the number and character of the witnesses, that it cannot be overcome. Of course, it is a question of fact depending upon the weight of the evidence, and involves no question of law, and therefore it is a matter that does not require much observation on the part of those who dissent from the opinion, which is very ably drawn, and undoubtedly presents the whole case with great force. But on this point we cannot concur in the views of the court. We think that Drawbaugh did have an instrument in his shop as early as 1869, which used the variable resistance instrumentality in transmitting articulate speech to a distance, by means of electricity, and was distinctly heard and understood. That is the whole invention, so far as variable resistance is concerned.

We also think that as early as 1871, he did produce an instrument employing the magneto-electric instrumentality altogether, substantially the same as that which is claimed in Mr. Bell's patent. In the one case, with regard to the variable resistance principle, over seventy witnesses were produced. The evidence of some of them may have been shaken with regard to the time.

In regard to the other instrument, some forty or fifty witnesses were produced who saw it. Many of them heard the language produced through it, and a number of witnesses who did not hear the language produced through these instruments, saw them or heard them talked about, so as to fix the time that they were in existence, and it seems to us that on this subject of time and of result, there is such a cloud of witnesses that it is impossible not to give credence to them. There is no doubt that Mr. Bell's merits are very great in appreciating the importance of the discovery, and in bringing it before the public in such a manner as to make it appear to be what it is, one of the most important discoveries of the century. He was a man whose professional experience and whose scientific attainments enabled him to see at a glance the importance of it. Drawbaugh was a different sort of man. He did not see it. Had he done so, he would have taken measures to interest persons with him in it, and have brought it out. He was a mechanic, a plain mechanic, somewhat better instructed, perhaps, than most ordinary mechanics, a man of more reading, a man of more intelligence. But he looked upon what he made more as a curiosity than a matter of speculation, a matter of financial importance or of importance to the public. That is the way we view his condition of mind in regard to it, and explain why he had not taken more pains to bring it forward to the notice of the public. It is the tendency of the human mind to attach importance to the results and inventions of those who have achieved eminence. Watt was the idol of the British nation, from the time of his first invention of the steam-engine until the day of his death, and until the present time; and everything that was invented about the steam-engine was attributed to him. It was the glory of England, the glory of Watt, and of course every patriotic British subject would hoot at anything it was claimed Watt did not invent, or attribute it to him. That is a principle of the human mind on which we think a great deal may be explained with regard to the feeling towards this important service which Mr. Bell has rendered with regard to this invention. The plain mechanic of Pennsylvania is of no account. The scientific and illustrious—for he is illustrious—Mr. Bell, it cannot be but that he did invent this thing! And yet if Mr. Bell on the 14th day of January (I think it was) or February, when he applied for his patent at the Patent Office, had had in his laboratory the things that Drawbaugh had, he would have been filled with an excitement far exceeding that which has animated great inventors of the world when they made the discoveries they have made, and he would have exclaimed: "Eureka! Eureka!" He would have appreciated it, if Drawbaugh did not.

What had he when he applied for his patent? On the 10th of June, 1875, they thought they heard something, but were not sure; but he knew the principle and he patented it. Up to the time of making his application for a patent they had not succeeded in producing intelligible speech, more than a word or two; perhaps a word or two. If Bell had done at that time as much as Drawbaugh had done, according to the evidence, he would have had no hesitation in claiming the greatest discovery that the world has seen in the present century.

This is an outline of the views which we have on this subject. We have nothing to to say depreciatory of Mr. Bell at all, for he has real merits; but we think that this obscure mechanic did do the thing, and that he is entitled to the merit of being the first inventor.

Telephonic News

*** The few remaining infringing telephone exchanges can truly be said to be in a moribund condition.

*** Mr. J. J. Storrow, the very able chief attorney of the American Bell Telephone Company, deserves to be congratulated on his masterly management of the Bell cases.

*** Mr. Edward P. Thompson, patent attorney, New York, desires his friends to know that he is not the Mr. Thompson reported killed in the recent railroad accident in the South.

*** With commendable enterprise, the *Electrical Engineer*, of New York, issued a supplement last week containing a verbatim report of the Supreme Court decision in the telephone cases.

*** The Bell Telephone Company of Missouri has demanded that all the Pan-Electric telephones scattered around in St. Louis be turned in to them. Many have complied. When all the Pan phones are turned over to the Bell Company, the latter propose to have a great bonfire and burn them.

*** The People's Telephone Association, of Rochester, N. Y., which was formed to tell the Bell Telephone Company how to manage its business, is not feeling particularly vigorous since the Supreme Court decision. They probably now sincerely wish they had accepted the very fair proposition recently made by the Bell Company.

*** Mr. W. A. Bunting, manager of the Telephone Exchange, at Morristown, Pa., announces that an all-night service will begin on April 1st. The preliminary arrangements are now being made, including the partitioning off of a room in the Exchange to provide sleeping accommodations for the operator. An electric bell will be provided, which will make life a burden to the night operator.

*** "*Bell discovered the way of doing it.* He was the first discoverer, and with the discovery he astonished the scientific world. A patent for such a discovery is not to be confined to the mere means which the discoverer improvised to prove the reality of his conception. The court is therefore of the opinion that the patent must be sustained as a patent for a process or art."—*U. S. Supreme Court Decision.*

*** The Great Southern Telephone Company are nearing the completion of their main line from Sunflower Landing to Eagle Lake, Miss., a length of nearly 200 miles. The construction is said to be first-class. Offices are in operation at all principal river points, such as Australia, Concordia, Terrene, Rosedale, Riverton, Stormville, Bolivar, Mound Landing, Belmont, Winterville, Longwood, Leota, Skipwith, Mayersville, Ben Lomond, Hall's Landing, Chotard, and many other landings.

*** Cleveland—Hello, hello!

Garland—Well, who are you?

Cleveland—Don't you know the voice?

Garland—O, yes, I catch on now.

Cleveland—You see we're knocked out?

Garland—Yes, and the worst of it is that we impecunious gentlemen have to talk over the Bell fraud—beg pardon, the instrument which has just been sanctioned by the Supreme Court of the United States. Say!

Cleveland—Well?

Garland—No higher authority, is there?

Cleveland—Just wait a minute until I ask Dan to look it up in the Encylopedia. (Pause.) Hello!

Garland—Well, how is it?

Cleveland—I guess we've got to give it up. We made one great mistake.

Garland—How so?

Cleveland—Didn't appoint Lamar early enough. Good-bye.

Garland—Good-bye.—*N. Y. Tribune.*

Mr. Stephen D. Field, of the Field Electric Motor Company, has recovered his health after a severe sickness.

The Common Council of Corunna, Mich., has granted the right of way through Corunna to the Port Huron electric railway company for an electric railway between that city and Owosso.

The Sprague Motor street car system in Wilmington, Del., is running smoothly, and the line is well patronized. 1,500 fares were taken in last Sunday by two cars, which is a remarkably large showing for that city.

Amendment has been made to the articles of incorporation by the Franklin, Ohio, Street Railroad Company, changing the name to the Franklin Electric Railway, Light and Power Company, and also enlarging its purposes.

The public are more interested in electric power for traction purposes than in any other respect. They must not be too impatient. There is much brain tissue being expended in study and experiment in this direction.

A novel application of the electric motor is in use running the vertical panoramic signs on Court street, Boston. A three horse power electric motor does the work and does it efficiently, although the heavy canvas signs are each 20 feet wide and 20 feet long. An ingenious contrivance at the motor reverses the motion of the canvass when necessary. This "ingenious contrivance," as reported to your correspondent, was investigated recently, and found to be a very affable specimen of the genus *homo*. There is certainly a field there for an inventive genius to do this work automatically and allow the biped to descend from his lofty perch.

At a regular meeting of the Academy of Science at Rochester last week, Professor Albert L. Arey read a paper on "Electric Motors," which was followed by discussion. The paper treated of the different modes of producing electricity from the rudest and simplest to the latest and most complete mechanical devices. The subjects of the magneto-electric and the dynamo-electric machines, modulated currents, commutators, the work of the French scientists and the introduction of the ring armature, securing a continuous current, were among the details of the subject in hand. Considerable interest in the contents of the papers was manifested by those present. Professor Arey illustrated his statements by diagrams and models.

Electric Motors and the Steam Engine.

There are certain enthusiasts who do not hesitate to say that the motor of the future will be the electric motor, and that the use of motive power is to be almost indefinitely extended. But, with curious inconsistency, they assert, in the same breath, that the steam engine must go. Those who look a little deeper into cause and effect understand that if the wildest dreams of electric enthusiasts were instantly realized, so far as to use electric motors—if it were possible—wherever power is now furnished direct by steam engines, the world would be enormously short in steam engines, and steam engine building would be, for a time, by far the greatest business of the age. The power that does the work of the world by steam would be entirely inadequate if this power had to be furnished through the connecting link of electric motors, with the attendant waste of energy. The steam engine will stand at least until the dreams of those who hope to make electricity direct from coal assume tangible form, and even then there is great probability that it will continue to be "the great prime mover." This is not saying that electric motors will not come to be used to a considerable extent, but steam engine builders can console themselves with the fact that every one substituted for steam direct will give them more instead of less work.—*Am. Machinist.*

Valuable Points for Arc Companies.

RULES AND REQUIREMENTS OF THE NEW ENGLAND INSURANCE EXCHANGE FOR ELECTRIC LIGHTING BY THE ARC SYSTEM.

The following has been adopted March 1, 1888, by the N. E. Insurance Exchange, and superseding all previous rules relating to arc lighting:

OUTSIDE WIRES.

1. All outside overhead wires must be covered with some material of high insulating power, not easily abraded, and impervious to moisture; and they must be firmly secured to properly insulated and substantially built supports. All tie wires must be insulated the same as conducting wires.

2. All joints must be so made that a perfectly secure and unvarying connection, fully equal to the cross-section of the conducting wire, will be secured—and they should be soldered. Resin must not be used as a flux. Nothing stronger than a 10 per cent. acid solution should be used, and any excess should be washed off before the splice is covered. This also applies to inside wires. All joints must be securely wrapped with at least five layers or ply of an approved tape.

3. Care must be taken that conducting-wires are not placed in such position that it would be easy for water, or any liquid, to form cross-connection between them, and they should not approach each other nearer than one foot.

4. The wires must never be allowed in contact with any substance other than air, and their proper insulating supports.

5. Conducting-wires carried over or attached to buildings, *must* be at least seven feet above the highest point of flat roofs, and one foot above the ridge of pitch roofs. Lines constructed subsequent to the adoption of these regulations should not be run over and attached to buildings other than those in which the light or power is being, or is to be used, but should be on separate poles, where they can be easily reached for inspection.

6. When they are in proximity to other conducting-wires, or any substance likely to divert any portion of the current, *dead, insulated* guard-irons must be placed so as to prevent any possibility of contact in case of accident to the wires, or their supports. The same precautions must be taken where sharp angles occur in the line wires, and also where any wires (telegraph, telephone, or others) could possibly, owing to their position, come in contact with the electric light wires.

7. Overhead wires from the main circuit or pole in the street to the terminal insulators attached to buildings, and at the point where they enter a building, must not be less than twelve inches apart. They must be rigidly and neatly run and supported by glass or porcelain insulators, or rubber hooks. The rubber hooks must be of an approved pattern, *i. e.*, with the rubber insulation free from flaws, and projecting over the hook in cup form.

8. Service blocks must be protected by at least two coats of water-proof paint over their entire surface; and when used to support rubber hooks, must have at least one inch of wood between the inner end of the hook and the back of the block.

9. For entering buildings, wires with an extra heavy water-proof insulation must be used from the terminal insulators outside to the inside of a building. They must loop down, so that water may drip off, without entering the building, and the holes through which they enter must slant upward.

10. Service wires must come in contact with nothing save air and their insulating supports, except in unavoidable cases, when a wire with an extra heavy insulation, suitable for the purpose, must be used.

11. The use of porcelain knobs as insulators, except in perfectly dry places or for the support of specially insulated wire, will not be allowed.

12. Soft rubber tubing will not be accepted as a durable water-proof insulation.

13. Wires must enter and leave a building at the same point, and through an approved cut-out switch.

14. The cut-out switch must be "double contact," and should effectually close the main circuit, and cut off the interior, when turned "off." It must be so constructed that there shall be no arc between the points when thrown "on" or "off." It should be automatic in its action in either direction, not stopping between points when once started. It should indicate, upon inspection, whether current be "on" or "off."

15. It must be mounted on a non-conducting base, kept free from moisture, and be easy of access to firemen and police.

INSIDE WIRES.

16. All wires must be run on walls or ceilings in plain sight, and so as to be open to inspection at any time. They should be kept apart at least twelve inches.

17. In perfectly dry places they may be supported by cleats of wood or porcelain.

18. In wet or damp places a specially insulated water-proof wire must be used, supported by glass or porcelain insulators or hard rubber hooks.

19. When wires pass through walls, floors, partitions, etc., in-doors, an extra sheathing of wood or hard rubber should be used. Wires must never be left exposed to disturbance or mechanical injury.

ARC LAMPS.

20. The frames and other exposed parts of arc lamps must be carefully insulated from the circuit.

21. Each lamp must be provided with a proper hand switch, and also with an automatic switch which will shunt the current around the carbons should they fail to feed properly.

22. Stops of some kind must be provided to prevent the carbons from falling out in case their clamps fail to hold them; and these stops must always be in place when the lamp is burning.

23. Lamps must be provided with globes that are closed at the bottom. When placed near combustible material, flyings in fabric factories, or in wood-working establishments, etc., very high globes or spark-arresters surrounded by wire netting must be used. Globes, when broken, must be immediately replaced.

24. Electrical connection between the conducting-wires and lamps must be made through a suitable "hanger-board" and rods on which the lamp is hung.

INCANDESCENT LAMPS ON ARC LIGHT CIRCUITS.

25. The rules for running wires for arc lamps apply also to incandescent lamps run in series.

26. These must be provided with a proper hand switch, and also with an automatic switch or other device which will shunt the circuit around the carbon filament should it break, and thus prevent the maintenance of an arc beyond the terminals of the wires inside the globe.

MULTIPLE SERIES BOXES OR DISTRIBUTORS.

27. Distributors must have the approval of the Exchange before they are put in operation.

28. Wires leading to the distributor, or to supply a series of individual distributors, must be at least twelve inches apart.

29. Wires must be run in plain sight.

30. Wires running from distributor or regulator to the fixtures and lamps, and from mains to individual distributors, must be kept three inches apart.

31. The safety fuses must be so proportioned that they will melt long before the wire is heated to an unsafe degree.

32. Dust must not be allowed in the distributor box, or on any of the electrical connections.

33. The contact points should be kept clean; solid electrical connections must be secured, and parts kept free to move easily.

34. In case any defect should arise in the distributor or regulator, or the wiring thereto, it must be arranged so as to automatically and absolutely shunt off from the main circuit.

35. Individual distributors must not be hung from the ceiling by a flexible conducting cord or cable, but should be rigidly attached to the ceiling by means of a pipe connection. The distributor must not be less than six inches from the ceiling. It should not be hung or placed near any inflammable material. Broken lamps must be replaced at once, or the entire series turned off.

36. Key-sockets, as a rule, must not be used on individual lamps. The pipes or fixtures should be fastened to a wooden block before being fixed to the walls or ceiling.

37. Lamps, distributors, or electroliers must not be attached to any gas pipe or fixture which may be electrically connected with the earth.

DYNAMOS AND MOTORS.

38. Dynamos and motors must be located in a dry place, not exposed to flyings of combustible materials, and must be well insulated upon dry, well varnished wooden foundations. They must be kept thoroughly clean and dry.

39. The wires leading to motors should be separated at least twelve inches from each other, and must be provided with an approved cut-out switch, at the point where they enter the building. The same precautions must be observed in entering the building that are required for lighting circuits.

TESTING.

40. All circuits should be tested at least twice a day with a suitable magneto, in order to discover any escapes to ground that may exist. One test should be made in the morning, and another in ample time before starting, to remove any defect, should it be found to exist. The rules for testing should be observed in any separate or isolated plant the same as in central stations.

41. The New England Insurance Exchange reserves the right at any time to add to, change or modify these rules, and to enforce such modifications, changes, etc., as it shall deem necessary for safety; and it will use all reasonable efforts to promptly notify all electric light companies of any change.

42. The signing of these rules by any electric lighting company, or persons controlling electric lights, shall be considered as a guaranty on their part that they will have the testing performed on their circuits, or lines as above required.

A Convenient Message Hook.

A new message hook and letter file combined, illustrated on this page, and known as the "Harpoon Security," is being received with much favor by the telegraph fraternity.

The security device in this hook consists of a gravity barb or tongue pivoted at one end, which drops naturally into the position shown in the engraving. In filing a paper on the hook, the barb or tongue is forced up into a pocket and allows the paper to slide along the wire, making only a small round hole without slotting or tearing it. When the paper is filed the barb falls again into its normal position, preventing the paper from being pushed or blown off the hook.

Manufacturing Notes.

The demand for fine platinum is constantly increasing, and the leading manufacturers and refiners in this country, Messrs. Baker & Co., of Newark, are crowded with orders.

The Bernstein Electric Light Manufacturing Company, Boston, is now actively in the field with its new lamp, which General Manager Cram has recently perfected. The lamp is supplied from arc circuits.

Messrs. Holmes, Booth & Haydens report a most satisfactory demand for their "K. K." wire in electric lighting circles. This wire was early in the telegraph and telephone field, and now, in addition, is meeting with favor among electric light companies. A recent order for New York City use was for 20 miles. In all there is about 1,500 miles in use in New York City.

The Bridgeport Brass Company, Bridgeport, Conn., has recently issued a table giving the resistance per mile and weight per thousand feet and per mile for all sizes of their patent insulated wire from 4-0 to No. 20. Also the cost per thousand feet and per mile at from 15 to 30 cents per pound advancing by quarters. They are sending these tables to all inquirers free of expense.

The Jarvis Engineering Co., No. 61 Oliver street, Boston, Mass., report business in a very flourishing condition. They are building a brick chimney and setting a boiler with the Jarvis Furnace for the Beach Soap Works, Lawrence, Mass. They have received the order to set a boiler for J. B. Besse & Sons, Albion, Me., furnishing Sheffield grate, bars, &c., and are soon to set two boilers with the Jarvis Patent Furnace at Hotel Berwick, Boston, Mass.

The New Haven Clock Company has moved its New York store from 16 and 18 Park Place to 29 Murray and 33 Warren streets. The company will keep a full exhibit of electrical apparatus in stock, and will fit up the show rooms in handsome style. No general stock will be carried, the long distance telephone service between New York and New Haven making that unnecessary. Mr. J. G. Noyes will be, as before, at the head of the electrical department.

Arc Lights in a Silk Mill.

The firm of R. & H. Simon, Union Hill, N. J., have accepted the 70 light arc plant installed in their mills by the Waterhouse Co., of Hartford, and express much satisfaction at its behavior. They did not believe any arc light could be used in a silk mill.

How Wires and Cables are Made.

We present views of several of the working rooms of the factory of the Okonite Company at Passaic, N. J. This company is extensively engaged in the manufacture of electric light, telephone and telegraph wires and cables, and is widely and favorably known in these fields. The rooms devoted to vulcanizing and covering, and to the manufacture of cables, are of especial interest. The compound, after which the company is named, is the result of much experimenting and testing, and is, of course, a secret with the manufacturers. The okonite is put on the wire before vulcanizing, and a perfect evenness of covering is obtained. An ingenious method of manipulation to this end was recently described in the *Scientific American*. On one of the long tables in the covering room are smoothed out long strips of thinly rolled pure tin, some fourteen inches wide, which are brushed over with a sort of thin varnish, to insure perfect freedom from any dust or dirt, and to prevent the okonite from sticking to the tin. Over these strips the okonite is rolled out to entirely cover the tin, to the size of which it is trimmed, and make a long, smooth band of thin okonite, with a thin tin backing. These bands are then drawn through a cutting machine, by which they are cut into narrow, tape-like strips, and automatically wound upon a reel with many divisions, each tape-like section into its especial division. Thus prepared, the tape-like sections being afterward joined at their ends as the whole are placed on a single reel, the okonite is ready for use in covering the wire. The reel carrying the tin-backed narrow strip of okonite, its width and the thickness of okonite being dependent on the size of wire to be covered and its intended use, is then mounted to feed out in connection with another reel or drum carrying the wire, these reels being located at some distance from the covering machines, so that the wire and covering may be allowed to feed without appreciable tension. At the covering machine they come together and pass through dies, the wire being thereby so thoroughly wrapped around by the okonite and its tin backing as to make the covered wire look like a wire of tin of several sizes larger, so perfect is the covering. The necessity of doing this work thoroughly is obvious when it is remembered that the now covered wire has yet to go into the vulcanizing oven, where it is subjected to a temperature of 275° F. for an hour, the heating being effected by turning the steam directly into the vulcanizers. Any flaw in the tin covering of the okonite would thus be likely to cause pricks or other defects in the okonite.

In Fig. 2 may be seen a representation of these vulcanizing chambers, of which there are several of various sizes in the factory, and the large drums in the foreground, on which the wire is wound as it comes from the covering machine, these drums being mounted on low carriages so that they can be conveniently moved about the floor, or rolled from their carriages into the vulcanizing chamber.

After vulcanization, the tin covering or wrapper has to be removed from the okonite-covered wire, and this is effected by passing it through a stripper, the operation, as well as that of covering, being effected with a rapidity which hardly seems possible until one has seen it actually accomplished, each conductor, whether it be for a single line wire or one of even hundreds of conductors in a large cable, being thus thoroughly and evenly covered with a strong and durable insulating covering. The company afford any size of wire or insulation, although they use a standard of regular thicknesses of insulation for the usual sizes of wire, as, for instance, No. 18 wire, according to the Birmingham wire gauge, is furnished with six different thicknesses of insulation, varying from 4.32 to 9.32 of an inch, thus in the cabling room shown in Fig. 3 are small machines for putting several conductors together in one wrapper, and larger machines for uniting these several strands as it were in a large cable. The strands are fed from spools or reels through apertures in a revolving disk or plate, the reels having a double motion, so that the wires will not be twisted as the cable is formed, the conductors being covered with an extra insulating wrapper and then strongly bound together as the operation proceeds with an insulating material composed of two or four layers of strong tape, with okonite composition between the same, to protect it from injury during handling and use, and an additional protection from dampness or water.

The factory is thoroughly equipped with everything necessary to the manufacture of first-class insulated wire and cable. A testing room, with all essential instruments for testing the insulation, is an important part of the establishment.

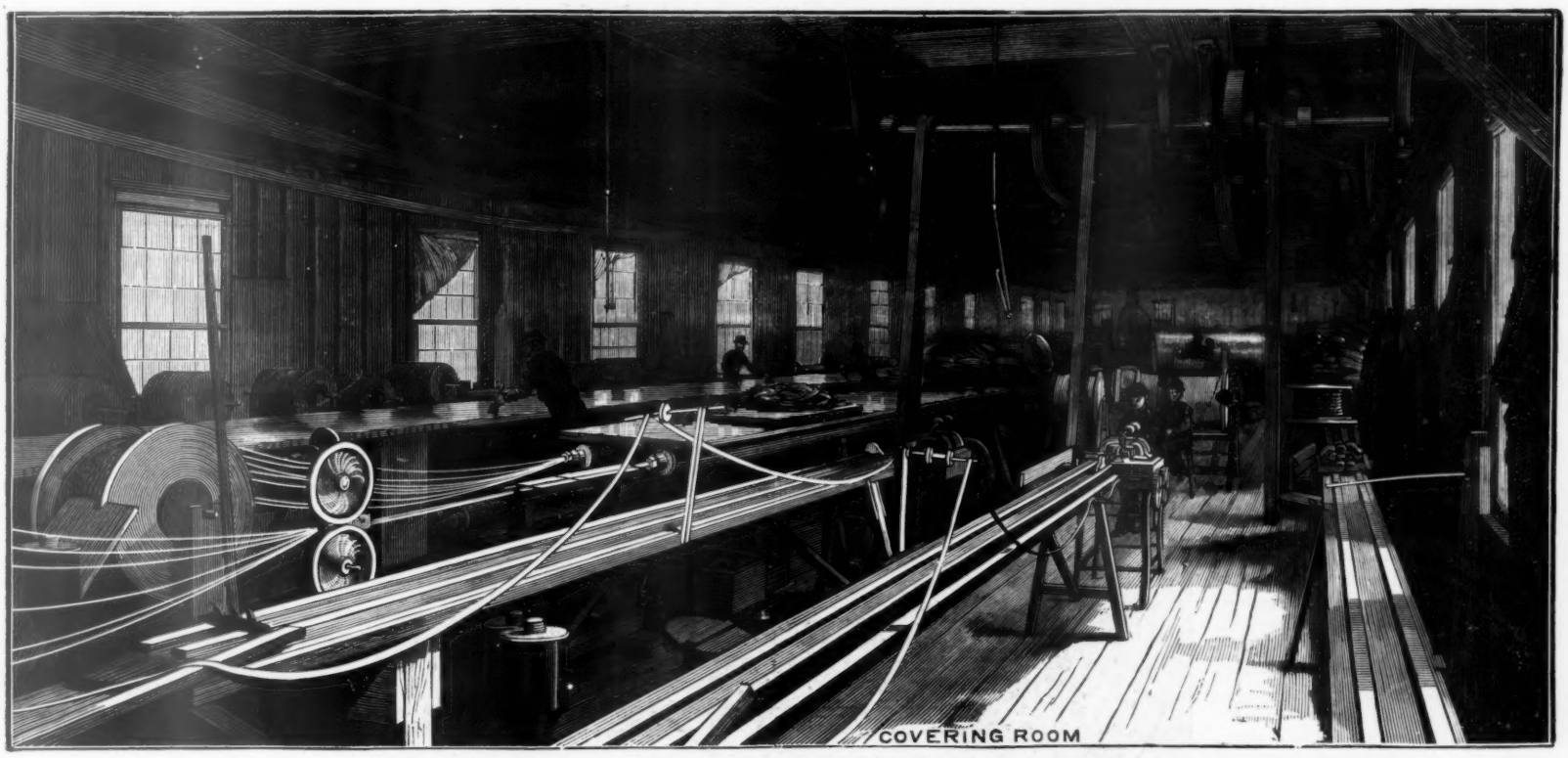

FIG. 1.—FACTORY OF THE OKONITE COMPANY.

Gas Engine and Arc Lights.

At Washington, Ind., the local gas company are using a 25 H. P. Otto Gas Engine, driving 35 Waterhouse lights of 1700 c. p. each. At one time in the evening 17 of these are extinguished, and later 9 more; yet the remainder are not affected in either case.

The Primary Battery Man.

The inquiry in the REVIEW of March 17th relative to the primary battery inventors, has discovered one of these whose last address was on the verdant banks of the Coosa river. That is to say, one of him, for he is many. One of him once resided on a branch of the Arkansas river, and one is just now cooling his heels in the wilds of upper Michigan.

The local community on the classic banks of the Coosa became a fishing pool for the primary battery man the other day, and this is the bait wherewith he angled. In the local journal was this advertisement in the want column:

"WANTED.—$800 to purchase the State rights for X—— of the —— Primary Battery (which also includes an exhibit installation of battery and incandescent lamps), which does away with the use of engines, boilers or dynamos, the battery being similar to those in telegraph offices, and can be produced at twenty-five cents per week for each light, and is also very successfully used in central stations to supply customers that are located in and around such stations."

In those far away sunny climes there were fish that swallowed the bait, and the following week the local journal, with double leaded pride and full-faced headlines, descanted upon the value of the sheet as an advertising medium, and eagerly blew its horn while it announced that the fish was successfully landed.

There will come a day of weeping and wailing and repentance on the banks of the Coosa, as there is on the banks of the tributary to the Arkansas, where even larger fish are to-day floundering helplessly on the grassy banks.

Where next will the primary battery man cast his lines? Certainly not in the tributary to the Arkansas, not in the Coosa—but he will come. He is as certain to come as young sparrows.

ELECTRIC LIGHT NEWS

—— Providence, R. I., has added 60 additional electric lamps for its street lighting.

—— Marlboro, Mass., will expend $2,400 for electric light for public street lighting for the year 1888.

—— The entire Senate wing of the Capitol is to be lighted, for the first time with the electric light, this week.

—— Electric lights, sprinklers, and steam heaters have been put in the Henrietta Mills, Henrietta, N. C. Good for the Henrietta.

—— The Menasha, Wis., Electric Light Company commenced to light the streets of the flourishing little City of Menasha with 25 arc lights of the Brush system, Tuesday, March 20.

—— C. A. Ballou, as agent of Thomson-Houston Electric Light Company, is engaged in erecting at Henderson, Va., a 50 light plant; also a 50 light plant at Oxford, N. C., and a 30 light plant at North Danville, Va.

—— The strike of the Sandwich flint glass workers, which was begun on January 2, is believed to be nearing its end. Should a favorable settlement not be reached, the strikers have plans for running co-operative factories.

—— The little town of Burrton, Kan., with only 1,000 inhabitants, is now lighted by the electric light from storage batteries of the Electrical Accumulator Company. The local people interested celebrated the inauguration of the system in a very pleasant banquet a few days ago.

—— On the 7th inst., Mr. Mulliken tendered his resignation of the office of superintendent of the Cambridge Electric Light Company, to fill a position of emolument in a larger field. Having learned that on last Wednesday evening, Mr. Mulliken would take his leave of the station, on that evening the employees presented him with a handsome silver water pitcher. Mr. Mulliken, in return, presented each employee with a large photograph of the interior of the station, a grouped photograph of all the employees, a cabinet picture of himself, and a letter of recommendation.

ELECTRICAL AND SCIENTIFIC

* * John G. Allen, foreman of the Corliss engine works at Providence, died last week, aged 45 years. He was born and has always resided at Pawtucket. He sat up and ran the famous Corliss engine at the Centennial Exhibition in Philadelphia, 1876, and has set up the Corliss engines in different parts of the country. He was widely known as a machinist.

* * Ten years from now underground wires will have proved a greater nuisance than overhead wires are now. Digging up streets is a common occurrence now, but it will be universal when half the wires are buried. A defective electrical conduit, charged with electricity of high potential, needs only a leaky gas pipe to render its neighborhood as dangerous as a powder mill.—*Manufacturers Record.*

* * At the junction of Ocmulgee and Ohoopee Rivers in Tatnall county, Ga., in the centre of an old deserted field, stand four trees, one of them half demolished from a lightning stroke. The other three have intertwined their branches in such a manner that when seen from a distance they seem to form three gigantic figures "8." The fourth tree furnishes a figure "1," and altogether, when seen from a distance, read "1888." The freak was discovered by some negroes while returning from camp meeting, and they think that during the present year either war, pestilence, or the end of the world will come. The road that passes near the deserted field is now seldom used, through the fear of the people for the supposed omens of evil.

* * In a new type of accumulator, which is a development of a battery proposed by Faraday and described by De la Rive in 1856 in his "Traité d'Electricité," the negative plates are formed of tinned iron wire netting, and the positives consist of plates of pure porous copper, obtained by subjecting porous electrolytic copper to a pressure of 3½ to 7 tons per square inch. The positives are wrapped in vegetable parchment, and separated from the negatives by india-rubber insulators; the whole is immersed in a solution of zincate of potash or soda in a tin box.

On charging this accumulator, the zinc is deposited on the negative plates, while the positive copper plates are either partially converted into a suboxide of copper or the oxygen is occluded. On discharging, the zinc is redissolved and the copper loses its oxygen.

The Work of Telephones and Alternate Current Machines.

Two telephones in circuit may be looked upon as an alternate current machine in connection with an alternate current motor, and the efficiency of the receiving telephone should follow all the laws applicable to a motor.

The induced current and the movement of the diaphragm of the transmitter will be simple periodic functions of the period of vibration. The equations established show that, if the E. M. F. of the receiver is equal to the E. M. F. of the transmitter, then the efficiency is unity—the phases are equal—but no work is done, as there is no current transmitted; in all which points the telephones agree with the laws for motors.

From a consideration of the vibrations of the elastic diaphragm, it follows that the efficiency depends only on the receiver and on the resistance of the line, and is independent of the transmitter and of the time of vibration. Comparing the work done by the transmitter with that taken up by the receiver, it follows that generally the acoustic efficiency is almost independent of the time of vibration; so also is the mechanical efficiency.

The resistance opposed to the current includes, besides the dead resistance of the line, the effects of self-induction and the counter E.M.F. of the receiver.

If the transmitter and receiver are similar instruments, the mechanical efficiency is never more than one-half; and if the damping is very slight the electric and acoustic efficiencies are equal to unity, and the mechanical efficiency is equal to one-half.

The transmitter and the circuit being given, it is possible to calculate the form of receiver in order that it may absorb the maximum of electric work. The formulæ are applicable to the case of two alternate current machines, one being used as a generator and the other as a motor.

Synchronization of Standard Clocks.

To the pendulum of the clock to be synchronized is fixed, either above or below the bob, an iron bar magnet, curved to coincide with the circumference of a circle described about the point of suspension as center. Two coils are arranged, one on each side, so that the curved magnet can swing through their hollow centers. One coil is in circuit with a battery and the synchronizing clock, and acts by attraction on the magnet. The other coil is in circuit with a resistance only, and the current induced in this coil by the movement of the magnet tends to damp the motion of the pendulum.

The current in the synchronizing circuit need not be very powerful, since the coil acts tangentially at the arm of a long lever. Owing to the weak current used, the sparks due to the extra current on breaking the circuit are very small; and their injurious effect may be entirely eliminated by placing a condenser or a polarizable electrolytic resistance in a shunt circuit.

Method of Calibrating Bridge-Wires.—In order to calibrate the resistance of a wire one meter long exactly to one ohm, a wire of slightly greater resistance is taken, and a shunt is attached to the ends.

Struck by Lightning.

UNITED STATES SENATORS AND SUPREME COURT JUDGES STARTLED, AND MEMBERS OF THE HOUSE SUBDUED BY LIGHTNING'S FLASH.

At 2 o'clock on Wednesday afternoon, last week, a flash of electricity, followed by a terrific peal of thunder, struck the big dome of the Capitol, lighted up the face of the bronze statue of the Goddess of Liberty, glided down the iron sides of the dome, says a dispatch from that city, and scattered itself all over the interior of the building, creating great excitement among the statesmen. In the Senate the shock played havoc with its dignity. The day was dark and the Senators were being wooed to sleep by the monotonous reading of the clerk when the crash came and a big ball of fire went cavorting around over the glass ceiling. The clerk stopped reading as though he had been shot and looked up; so did all the Senators. Senator Stanford leaped from his chair, and placing his hand over his heart, gasped for breath. Mr. Edmunds quickly put on his silk cap to cover his bald head, and looked at Mr. Cockrell as though expecting to hear him say "I object." For once the Missouri Senator was silent. President Ingalls nervously fingered his ivory gavel for a moment, then called Mr. Dolph to the chair and went out. Nearly every man in the chamber showed signs of nervousness, but when the shock was past smiled knowingly at each other. Senator Vance actually started to run, and stopped suddenly, saying: "The wicked flee where no man pursueth."

After running around the roof for a moment the ball of fire entered the press gallery, and burned every telegraph wire. In the lobby of the press gallery a ball of fire dropped from each chandelier to the floor. In the sub-basement an engineer was knocked off his chair. A cab horse outside was knocked down.

In the House, the members had been engaged in an unseemly wrangle all day over the eight hour bill when the stroke came. "Balls of blue fire" played about the corridors, and each occupant of the House or of the committee rooms seemed to think he was the especial object of attack. The crash led some members of the House to the belief that the roof was tumbling in. Lane, of Illinois, who was speaking, sank into his seat in alarm, and no man spoke. Not even Tom Reed could think of a witty thing to say. Mr. Cox, who was standing in the aisle, jumped clear off his feet. Speaker Carlisle, forgetting himself, rapped for order, but it was not necessary. The lightning had made every member docile as a lamb, and for the remainder of the day all turbulence was subdued. Members who had assailed each other in the most bitter language, shook hands, apologized, and buried the hatchet. For an hour after the shock not an unkind word was spoken. As in the Senate, big sparks of fire from the numerous electric wires rolled about overhead and smashed all the telegraph wires.

In the Supreme Court chamber, which is nearer the dome than either the House or Senate, the shock was fearful. Every justice on the bench rose from his seat except Lamar. He, it is said, simply opened his eyes to see if the court had adjourned. Senator Evarts was talking to the clerk of the court at the time, and, making a laughing remark, hurriedly went over to the Senate. In the big rotunda beneath the dome the crash on the iron resounded like a bass drum, and a policeman nearly fell to the floor with fright.

There is a place near the rotunda door where all the electric wires of the dome concentrate. They were ablaze with fire, and the many promenaders were thrown into momentary consternation. The engineer of the Senate wing fell from his chair, a pane of glass in the lower floor was shattered, and a white horse attached to a coupé standing outside the Senate was scared to death.

The storm burst over the White House while the President was holding his usual tri-weekly reception. There were about 200 persons in the East Room at the time, the majority of whom were ladies, and the violence of the storm, with its accompaniments of thunder and lightning, created a temporary commotion, principally among the ladies and children. The reception was not interrupted, however, and the President continued to shake hands with each person presented to him. He retired to his office as soon as the last person had been presented, but the heavy rainfall compelled the crowd to remain in the East Room at least half an hour longer, before any but the bravest would venture out.

FIG. 2.—ANOTHER VIEW OF THE INTERIOR.

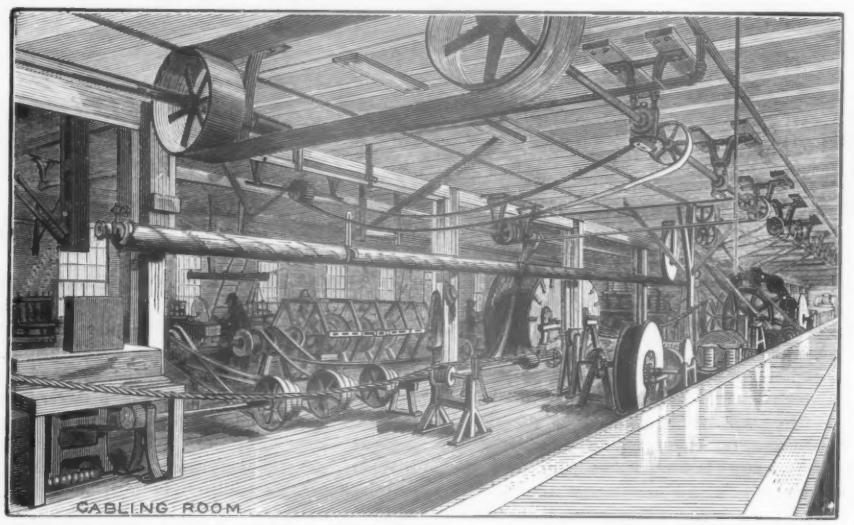

FIG. 3.—AT THE OKONITE FACTORY.

Von Hefner Alteneck's Amyl Acetate Standard of Light.

The author has investigated the effects of changing the dimensions of various parts of the lamp from the normal values as settled by the inventor. An important point in the constancy of the standard is the height of the flame; and the following table shows the results obtained by altering the height from the normal height of 40 millimetres:—

Height of Flame.	Illuminating Power.
20 mm.....0.38	standard candles.
25 " 0.55	"
30 " 0.70	"
35 " 0.85	"
40 " 1.00	"
45 " 1.12	"
50 " 1.25	"
60 " 1.50	"

Increasing or decreasing the diameter of the wick-tube by 2 mm. at a time diminishes the light by 1 per cent.; so that the dimensions chosen by von Hefner Alteneck give the maximum of light. An alteration of the portion of the wick-tube which rises above the body of the lamp by 1 mm. makes a difference of 0.2 per cent. in the light.

In the old form of the amyl acetate lamp the height of the flame is guaged by a sight carried on the top of a small rod fitting into the body of the lamp. Dr. Liebenthal has introduced an improvement on this arrangement. The lamp is provided on one side with a vertical screen, the upper edge of which carries a small camera; the lens is turned towards the flame, and has such a focal length that the image of the tip of the flame is seen clearly on a disc of white alabaster glass which forms the back of the camera; by means of a scale on the glass the exact height of the tip of the flame can be read in millimetres, the middle division corresponding to 40 mm.—*Elektrotechnische Zeitschrift.*

ELECTRICAL PATENTS

(Copies of any Patents in the following List will be sent to any address on receipt of twenty-five cents.)

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING MARCH 20, 1888.

379,567 Application of electricity to car lighting; Camille A. Faure, New York, N. Y., assignor to The Electrical Accumulator Company, of New York.

379,572 Electric storage battery; Charles D. P. Gibson, New York, N. Y.

379,598 Plug for making electrical connections; Gustav Otto, Jersey City, N. J.

379,689 Dynamo electric machine; Marcel Deprez, Paris, France.

379,758 Electric annunciator; Barnet N. Botts, Paso Robles, Cal.

379,766 Tele-Thermometer; Fernando J. Dibble, New York, N. Y., assignor to the Telemeter Company, of New York.

379,770 Incandescent electric lamp.

379,771 Regulator for dynamo electric machines.

379,772 System of electrical distribution; Thomas A. Edison, Menlo Park, N. J., assignor to the Edison Electric Light Company, New York, N. Y.

379,792 Electric arc lamps; Edward R Knowles, Brooklyn, N. Y., assignor to Albert M. Kalbfleisch, New York, N. Y., and the Mutual Electric Manufacturing Company, of New York.

379,802 Electro mechanical movement; James F. McLaughlin, Philadelphia, Pa.

379,816 Electro magnetic traction increasing apparatus; Elias E. Ries and Albert H. Henderson, Baltimore, Md.

379,822 Electric heater; Carl Seiler, Philadelphia, Pa.

379,832 Electrical stop motion for knitting machines; Wait Talcott, 2d, Rockford, Ill.

379,842 Socket and key for incandescent lamps; Gilbert Wilkes, U. S. Navy, assignor of one-half to Louis Duncan, Baltimore, Md.

379,904 Elevated railroad and conduit for electric wires, etc.; Albert C. Oehrle, Philadelphia, Pa., assignor to the American Pneumatic Railway Company, of Tennessee.

379,909 Traction increasing system for electric railways; Elias E. Ries, Baltimore, Md.

379,911 Galvanic battery; Alexander Schanschieff, Gipsy Hill, County of Surrey, assignor to the Schanschieff Electric Battery Syndicate, London, England.

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Manufacturer of Electrical Condensers
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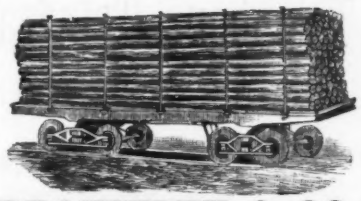

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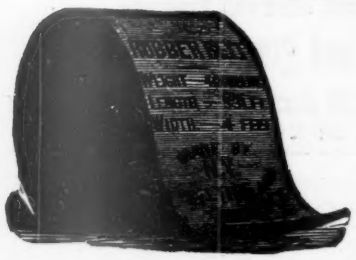

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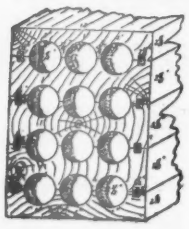

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